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ABSTRACT

This document provides a detailed outline of performance objectives and test items for an introductory secondary level physical science course. (SL)

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PHYSICAL SCIENCE

PERFORMANCE OBJECTIVES AND TEST ITEMS

Science Behaviors Outline
Science Behaviors Description
Content Outline
Content/Objectives/Behaviors Grid
Performance Objectives and Test Items

First Revision

Compiled by
Pete McVay

Norfolk City Schools
July, 1973

SE 023 117

SCIENCE BEHAVIORS

Outline

COGNITIVE DOMAIN

A.0 KNOWLEDGE

- A.1 Knowledge of scientific terminology
- A.2 Knowledge of facts
- A.3 Knowledge of classification schemes
- A.4 Knowledge of scientific techniques and procedures
- A.5 Knowledge of scientific concepts, principles, laws, and theories

B.0 COMPREHENSION

- B.1 Translation of knowledge to a new form
- B.2 Identification of knowledge in a new context
- B.3 Interpretation of knowledge, including data and observations

C.0 APPLICATION

- C.1 Solution of routine mathematical problems
- C.2 Recognition and identification of a problem
- C.3 Observation of objects and phenomona
- C.4 Measurement of objects and change
- C.5 Collection and processing of data
- C.6 Application of knowledge in new situations

D.0 ANALYSIS AND SYNTHESIS

- D.1 Formulation of an hypothesis
- D.2 Selection of suitable tests for an hypothesis and appropriate procedures for performing experiments
- D.3 Formulation of generalizations based on data and observations

PSYCHOMOTOR DOMAIN

E.0 SKILLS

- E.1 Skills in the use of common laboratory and field equipment and techniques
- E.2 Skills in mounting and preserving specimens, and in constructing graphs, charts, drawings, models, and maps
- E.3 Skills in oral expression

AFFECTIVE DOMAIN

F.0 ATTITUDES, INTERESTS, APPRECIATIONS, AND VALUES

- F.1 Manifestation of favorable attitudes toward science and scientists
- F.2 Commitment to a value system and adoption of scientific attitudes and the methods of scientific inquiry
- F.3 Enjoyment of science learning experiences
- F.4 Development of interests in science and science-related activities
- F.5 Realization of the interrelationships among the sciences, the humanities, and society
- F.6 Recognition of the historical background of science

DESCRIPTION OF SCIENCE BEHAVIORS

COGNITIVE DOMAIN

A.0 KNOWLEDGE

A.1 Knowledge of scientific terminology

Correct use and definition of scientific vocabulary.

A.2 Knowledge of facts

Recall of specific facts; for example, insects have six legs.

A.3 Knowledge of classification schemes

Ordering objects and phenomona in accordance with organizing structures established by scientists. For example, (a) Matter is classified into gases, liquids, and solids. (b) Criteria for classifying insects are a three-part body and six legs.

A.4 Knowledge of scientific techniques and procedures

This is to be distinguished from students' manual performance of laboratory techniques (a psychomotor skill) and use of procedures. It would include being able to recall and describe (a) how to use a microscope, (b) how to perform a titration, (c) how to test for starch, (d) how to determine density, etc.

A.5 Knowledge of scientific concepts, principles, laws, and theories

The acquisition and recall of the above. For example, the concept of cycles (life cycles, the nitrogen cycle), Archimedes principle, Mendel's laws, the theory of evolution, the kinetic-molecular theory.

B.0 COMPREHENSION

Comprehension of a fact, classification scheme, procedure, principle or theory is demonstrated by the students' ability to make some use of the above kinds of knowledge.

B.1 Translation of knowledge to a new form

The ability to translate information and relationships expressed in symbolic form, including maps, tables, diagrams, charts, and formulas into verbal and numerical form and vice-versa. For example: (a) A definition of density may be stated as a formula $d=\frac{m}{v}$. *(b) Written material may be read, summarized, and presented orally by the student. (c) A description of forces may be put into the form of a vector diagram. (d) Chemical equations may be translated into a verbal statement that the reactions are synthesis, replacement, etc. (e) A student may be able to transform an abstract idea into* *an example in everyday concrete terms or vice-versa. (f) Given the symbols, the student can explain their meaning on a weather map or a topological map or can construct such a map from given information.*

B.2 Identification of knowledge in a new context

Examples: (a) Having learned the concept of cycle in relation to the water cycle, the student will identify the life stages of flowering plants from seed to seed as a cycle. (b) Having learned the criteria for classifying organisms as insects when studying honey bees, the student will recognize that grasshoppers are also insects. (c) Having learned that $A + B \rightarrow AB$ *represents a synthesis reaction, the student will recognize that* $C + O_2 \rightarrow CO_2$ *is also a synthesis reaction.*

B.3 Interpretation of knowledge, including data and observations

Interpretation involves understanding of interrelationships and recognizing inferences from information. For example: (a) A student examines a distance vs time graph and determines whether or not a moving body is accelerating. (b) A student extrapolates from a graph or chart to predict. (c) A student reads material and determines if the data or information support the conclusion given.

C.0 APPLICATION

Application goes beyond comprehension. When a student "comprehends", he can use an abstraction or idea when its use is specified; but a demonstration of "application" shows he will use it in an appropriate situation for which no mode of solution is specified. Comprehension does not certify the ability to apply. Application is the behavior used in the first steps of problem solving. It refers particularly to application of principles to new situations.

C.1 Solution of routine mathematical problems

For example: (a) Having learned the formula for density, the student calculates it from the measurements of mass and volume. (b) the student calculates weight of product in a chemical reaction when given weight of reactants.

C.2 Recognition and identification of a problem

To sense a problem the student must recognize some sort of discrepancy, incongruity, or unanswered question.

C.3 Observation of objects and phenomona

The student makes observations which are appropriate and correct and can accurately communicate them orally or in some recorded form. The observation is qualitative only; as soon as it goes beyond simple counting and becomes quantitative, the student behavior represents category C.4 Measurement.

C.4 Measurement of objects and changes

The student can select, and properly use the appropriate measurement instrument with consideration for such matters as how to read a meniscus, accuracy, precision, significant figures, interpolation, estimation, how frequently to record data, etc.

C.5 Collection and processing of data

This includes collecting relevant data, recording it properly, assembling it in appropriate charts, graphs, tables, drawings, models, or maps, making calculations if necessary (such as correcting for daily atmospheric pressure changes), and analyzing error. This category also includes properly preserving, mounting, and labelling collected specimens, because they are field data.

C.6 Application of knowledge in new situations

Examples: (a) The student can predict the probable effect of a change in one factor on a biological situation (e.g. aquarium) previously in equilibrium. (b) Experimental procedures and scientific principles are applied to making a home repair. (c) Mendel's laws are applied in designing an experiment on plant genetics. (d) Without being told why, a student applies the idea of expansion because of heating to explain why there are expansion joints in bridges and roads.

D.0 ANALYSIS AND SYNTHESIS

D.1 Formulation of a hypothesis. The hypothesis will give direction to an investigation and lead to D.2.

D.2 Selection of suitable tests for an hypothesis and appropriate procedures for performing the experimental tests

The student selects tests which are indeed a valid test of a proposed hypothesis and selects or designs equipment and procedures so these tests can be implemented in an experiment. This behavior is not concerned with manipulative details, but with valid design of an experiment.

D.3 Formulation of generalizations based on data and observations

(a) The student analyzes data, develops relationships, indicates trends, determines whether or not the hypothesis is verified (b) and/or, using analyzed information from a variety of sources, he synthesizes factors in order to formulate a generalization. Example: A written report of a field, lab, or literature investigation which concludes with the students' own generalization(s).

PSYCHOMOTOR DOMAIN

E.O SKILLS

E.1 Skills in the use and care of common laboratory and field equipment and techniques

This category deals with manipulative and manual skills. Successful achievement calls for proper care of equipment and for techniques to be performed safely and with sufficient care to achieve good results.

E.2 Skills in mounting and preserving specimens, and constructing graphs, charts, drawings, models, and maps

This psychomotor skill is concerned only with the successful manual performance of constructing the above, with no requirement for knowledge, comprehension, or other cognitive abilities.

E.3 Skills in oral expression

This refers to the student's ability to make oral presentations or communications, but does not include cognitive abilities. For example, a student may be able to present an oral report to the class, speaking clearly and with poise; however the accuracy of material, the logic, relevance, or any other cognitive aspect of the report would not be considered in judging this skill.

AFFECTIVE DOMAIN

F.O ATTITUDES, INTERESTS, AND APPRECIATIONS

Evaluation of achievement in the affective domain is most difficult. Frequently observation by the teacher is the only way to evaluate affective behavior. Checklists lend objectivity to such observations and provide a means of recording them. Other evaluation instruments are: (1) personal discussions and interviews, (2) individual inventories, (3) student reports or term papers, (4) rating scales, (5) subjective test questions.

F.1 Manifestation of favorable attitudes toward science and scientists

This attitude is evidenced when the student speaks, writes, and acts in ways which show he places a value on the role of science in furthering man's understanding and gives due acknowledgment to scientists for their contributions in this quest. He does not denounce science as a sinister enterprise or consider scientists to be wierd people.

F.2 Commitment to a value system and adoption of scientific attitudes and the methods of scientific inquiry

Commitment to a value system could be evidenced by a student who holds a value firmly enough to stand up and defend it or whose behavior manifests his values. For example, (a) he will not hesitate to support an issue which may be unpopular with his peers, (b) he will indicate a respect for all living things and the environment.

Scientific attitudes reflect the nature of scientific inquiry and professional standards of the scientist rather than the personalities of scientists. The attitudes include honesty, open-mindedness, self-criticism, willingness to suspend judgment, and commitment to accuracy. The student whose mind is attuned to the methods of inquiry is characterized by more than mechanical performance of inquiry processes; his behaviors attest that he is personally convinced that scientific inquiry is a valuable and valid operating mode for him.

He will apply the methods and behaviors typical of scientific inquiry to the resolution of everyday problems; for example, in deciding on purchases, making decisions regarding school, interpersonal relationships, and career choice. He will perform tasks in a precise, orderly, well-organized fashion, will care properly for equipment he uses, and will work cooperatively within a group.

F.3 Enjoyment of science learning experiences

This category calls attention to an obviously desirable but frequently and sadly lacking aspect of school learning. The student who enjoys science learning will express his feelings clearly in words and in other ways. Teacher observations of such expressions must be employed to determine if the behavior indicates achievement of such an objective.

F.4 Development of interests in science and science-related activities

Two aspects of this interest are (a) activities the student does himself, particularly voluntarily, and (b) the attention he gives to ongoing science events and the societal interactions of science.

F.5 Realization of the interrelationships among the sciences, the humanities, and society

This category deals with the students' manifestations which indicate their awareness that (a) all sciences are interrelated, (b) the humanities and the sciences are interrelated and influence each other (science and music, art and science, etc.), (c) science influences society and vice-versa, (The attitude of government toward research funding; industrial and social needs vs. ecological considerations; etc.).

F.6 Recognition of the historical background of science

This refers to the history of scientific ideas and the evolutionary nature of their development, and students' recognition that the past, present, and future development of science is a reflection of the general culture of the time.

PHYSICAL SCIENCE

CONTENT OUTLINE

- 1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION
  - 1.10 Means of Gathering Information
    - 1.11 Using the Senses
    - 1.12 Using Tools
    - 1.13 Using the Methods of Science
  - 1.20 Controlled Experiments
  - 1.30 Measurement
    - 1.31 Measurement Systems
    - 1.32 The Metric System
    - 1.33 Length Measurement
    - 1.34 Volume Measurement
    - 1.35 Weight Measurement
    - 1.36 Temperature Measurement
    - 1.37 Significant Figures
    - 1.38 Graphing

- 2.00 THE NATURE OF ENERGY
  - 2.10 Sources of Energy
  - 2.20 Forms of Energy
  - 2.30 Transfer of Energy
  - 2.40 Transformation of Energy
    - 2.41 Transformation of Energy
    - 2.42 Energy Chains
    - 2.43 Use of Energy Transformations
    - 2.44 Law of Conservation of Mass-Energy

- 3.00 THE NATURE OF MATTER
  - 3.10 General Properties of Matter
    - 3.11 Mass
    - 3.12 Inertia
    - 3.13 Volume
    - 3.14 Density and Specific Gravity
    - 3.15 The Molecular Theory
  - 3.20 The States of Matter
    - 3.21 The Molecular Theory
    - 3.22 Properties of Solids, Liquids, and Gasses
    - 3.23 Sublimation
    - 3.24 Solids
    - 3.25 Liquids
    - 3.26 Gases
    - 3.27 Plasma
  - 3.30 Elements
    - 3.31 Atomic Theory and Structure
    - 3.32 Atomic Structure of Elements
    - 3.33 Periodic Table
    - 3.34 Symbols and Elements
  - 3.40 Compounds
    - 3.41 Molecules
    - 3.42 Properties of Compounds
    - 3.43 Chemical Formulas

- 3.50 Mixtures
  - 3.51 Physical and Chemical Changes
  - 3.52 Elements, Compounds, and Mixtures
  - 3.53 Solutions
- 3.60 Alloys

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER
- 4.10 Atomic Structure and Chemical Properties
  - 4.11 Atomic Structure
  - 4.12 Atomic Structure and Ions
  - 4.13 Electron Sharing and Transfer
  - 4.14 Chemical Changes
  - 4.15 Radicals
- 4.20 Chemical Reactions
  - 4.21 Properties of Chemical Reactions
  - 4.22 Nature of Chemical Reactions
  - 4.23 Types of Chemical Reactions
  - 4.24 Acids, Bases,and Salts
- 4.30 Chemical Equations
- 4.40 Chemical Laboratory Use

5.00 THE NATURE OF HEAT
- 5.10 Heat and Temperature
  - 5.11 Heat and Molecular Motion
  - 5.12 Heat and Temperature
- 5.20 Measurement of Heat and Temperature
  - 5.21 Nature of Temperature
  - 5.22 Measurement of Temperature
  - 5.23 Measurement of Heat
  - 5.24 Specific Heat
- 5.30 Effects of Heat on Matter
- 5.40 Sources of Heat
- 5.50 Heat Transfer

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM
- 6.10 Magnetism
- 6.20 Electrostatics
- 6.30 Current Electricity
  - 6.31 Current Electricity Theory
  - 6.32 Electric Circuits
  - 6.33 Direct and Alternating Current
  - 6.34 Ohm's Law
- 6.40 Energy Conversions

7.00 THE NATURE OF SOUND AND WAVES
- 7.10 Properties of Waves
- 7.20 Sound Waves
  - 7.21 Sound as a Wave
  - 7.22 Producing Sound
  - 7.23 Transmitting Sound
  - 7.24 Receiving Sound
  - 7.25 Sound Properties
- 7.30 Sound Conversion

- 8.00 THE NATURE OF LIGHT
  - 8.10 Light Energy
    - 8.11 Properties of Light
    - 8.12 Energy Conversions
  - 8.20 Measurement of Light
  - 8.30 Reflection and Mirrors
    - 8.31 Reflection
    - 8.32 Mirrors
  - 8.40 Refraction and Lenses
    - 8.41 Refraction
    - 8.42 Lenses

- 9.00 THE NATURE OF NUCLEAR ENERGY
  - 9.10 Atomic Structure
  - 9.20 Radioactivity
    - 9.21 Man and Radioactivity
    - 9.22 Properties of Radiation
  - 9.30 Nuclear Fission
    - 9.31 Uncontrollable Chain Reactions
    - 9.32 Nuclear Reactors
  - 9.40 Nuclear Fusion
  - 9.50 Energy Conversions
  - 9.60 Radioisotopes

- 10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES
  - 10.10 Forces
  - 10.20 Measurement of Forces
  - 10.30 Gravitation
  - 10.40 Newton's Laws of Motion
    - 10.41 Inertia
    - 10.42 Speed and Acceleration
    - 10.43 Action and Reaction
  - 10.50 Work
  - 10.60 Power
  - 10.70 Energy Conversions

PHYSICAL SCIENCE

Content/Behaviors Grid

		SCIENCE BEHAVIORS																							
		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
CONTENT	OBJECTIVE	Terminology A 1	Facts A 2	Classification A 3	Techniques/Procedures A 4	Concepts/Laws/Theories A 5	Translation to New Form B 1	Identify Knowledge in New Context B 2	Interpretation B 3	Solve Math Problems C 1	Recognize/Ident. Probl. C 2	Observation C 3	Measurement C 4	Collect/Process Data C 5	Apply Knowledge in New Situation C 6	Formulate Hypothesis D 1	Select Tests of Hypothesis and Procedures D 2	Formulate Generalizations D 3	Equipment and Techniques E 1	Construction of Graphs, Models, Mounts, etc E 2	Oral Expression E 3	Attitudes toward Science F 1	Values, Scientific Attitudes and Methods F 2	Enjoyment of Science F 3	Interest in Science F 4	Interrelationships - Sci/Humanities/Soc F 5	Historical Background F 6
1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION																											
1.10 Means of Gathering Information																											
1.11 Using the Senses	C.2/1.11a										X																
	C.2/1.11b										X																
1.12 Using Tools	A.4/1.12a				X																						
	A.4/1.12b				X																						
	E.1/1.12c																		X								
1.13 Using the Methods of Science																											
	A.5/1.13a					X																					
	C.1/1.13b									X																	
	A.3/1.13c			X																							
1.20 Controlled Experiments																											
	A.4/1.20a				X																						
	F.2/1.20b																						X				
	F.2/1.20c																						X				
	D.1/1.20d															X											
1.30 Measurement																											
1.31 Measurement Systems	B.3/1.31a								X																		
	C.2/1.31b										X																
	B.2/1.31c							X																			
1.32 The Metric System	A.4/1.32a				X																						
	A.4/1.32b				X																						

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	B.1/1.32c						X																				
1.33 Length Measurement	C.4/1.33a												X														
1.34 Volume Measurement	C.4/1.34a												X														
1.35 Weight Measurement	C.4/1.35a												X														
1.36 Temperature Measurement	C.4/1.36a												X														
1.37 Significant Figures	C.1/1.37a									X																	
1.38 Graphing	E.2/1.38a																			X							
	B.1/1.38b						X																				
2.00 THE NATURE OF ENERGY																											
2.10 Sources of Energy	A.1/2.10a	X																									
	A.3/2.10b			X																							
	B.2/2.10c							X																			
	B.3/2.10d								X																		
2.20 Forms of Energy	A.3/2.20a			X																							
	A.3/2.20b			X																							
	A.3/2.20c			X																							
2.30 Transfer of Energy	B.2/2.30a							X																			
	A.3/2.30b			X																							
2.40 Transformation of Energy																											
2.41 Transformation of Energy	B.2/2.41a							X																			
	B.2/2.41b							X																			
2.42 Energy Chains	D.3/2.42a																	X									
2.43 Use of Energy Transformations																											
	F.1/2.43a																					X					

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	B.2/2.43b							X																			
2.44 Law of Conservation of Mass-Energy																											
	D.2/2.44a																X										
	C.6/2.44b														X												
	B.2/2.44c							X																			
3.00 THE NATURE OF MATTER																											
3.10 General Properties of Matter																											
3.11 Mass	C.3/3.11a											X															
	A.1/3.11b	X																									
	A.5/3.11c					X																					
3.12 Inertia	A.1/3.12a	X																									
	B.2/3.12b							X																			
3.13 Volume	C.3/3.13a											X															
	A.1/3.13b	X																									
3.14 Density and Specific Gravity																											
	A.1/3.14a	X																									
	C.6/3.14b														X												
	C.1/3.14c									X																	
	A.5/3.14d					X																					
3.15 The Molecular Theory	A.5/3.15a					X																					
	B.2/3.15b							X																			
	C.6/3.15c														X												

SCIENCE BEHAVIORS

PHYSICAL SCIENCE

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3.20 The States of Matter																											
3.21 The Molecular Theory	B.3/3.21a								X																		
	D.3/3.21b																	X									
	A.5/3.21c					X																					
3.22 Properties of Solids, Liquids, and Gases																											
	A.3/3.22a			X																							
	A.5/3.22b					X																					
	B.2/3.22c							X																			
	D.1/3.22d															X											
	A.2/3.22e		X																								
3.23 Sublimation	A.1/3.23a	X																									
3.24 Solids	C.6/3.24a														X												
3.25 Liquids	A.1/3.25a	X																									
	A.1/3.25b	X																									
3.26 Gases	B.3/3.26a								X																		
3.27 Plasma	A.1/3.27a	X																									
3.30 Elements																											
3.31 Atomic Theory and Structure																											
	B.3/3.31a								X																		
	B.1/3.31b						X																				
	A.1/3.31c	X																									
3.32 Atomic Structure of Elements																											
	B.2/3.32a							X																			
	B.2/3.32b							X																			

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3.33 Periodic Table	A.4/3.33a				X																						
	D.2/3.33b																X										
3.34 Symbols and Elements	B.1/3.34a						X																				
	B.1/3.34b						X																				
3.40 Compounds																											
3.41 Molecules	B.1/3.41a						X																				
3.42 Properties of Compounds	B.3/3.42a								X																		
3.43 Chemical Formulas	B.1/3.43a						X																				
	B.1/3.43b						X																				
3.50 Mixtures																											
3.51 Physical and Chemical Changes																											
	A.3/3.51a			X																							
	B.3/3.51b								X																		
3.52 Elements Compounds, and Mixtures																											
	A.2/3.52a		X																								
	A.3/3.52b			X																							
3.53 Solutions	A.1/3.53a	X																									
	A.1/3.53b	X																									
	A.5/3.53c					X																					
3.60 Alloys	C.6/3.60a														X												
4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER																											
4.10 Atomic Structure and Chemical Properties																											

PHYSICAL SCIENCE

Content/Behaviors Grid

		SCIENCE BEHAVIORS																									
		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
		Terminology	Facts	Classification	Techniques/Procedures	Concepts/Laws/Theories	Translation to New Form	Identify Knowledge in New Context	Interpretation	Solve Math Problems	Recognize/Ident. Probl.	Observation	Measurement	Collect/Process Data	Apply Knowledge in New Situation	Formulate Hypothesis	Select Tests of Hypothesis and Procedures	Formulate Generalizations	Equipment and Techniques	Construction of Graphs, Models, Mounts, etc.	Oral Expression	Attitudes toward Science	Values, Scientific Attitudes and Methods	Enjoyment of Science	Interest in Science	Interrelationships - Sci/Humanities/Soc	Historical Background
CONTENT	*OBJECTIVE*	A 1	A 2	A 3	A 4	A 5	B 1	B 2	B 3	C 1	C 2	C 3	C 4	C 5	C 6	D 1	D 2	D 3	E 1	E 2	E 3	F 1	F 2	F 3	F 4	F 5	F 6
4.11 Atomic Structure	B.3/4.11a								X																		
	A.5/4.11b					X																					
	A.5/4.11c					X																					
4.12 Atomic Structure and Ions																											
	A.5/4.12a					X																					
	E.2/4.12b																			X							
	A.2/4.12c		X																								
4.13 Electron Sharing and Transfer																											
	A.5/4.13a					X																					
	B.3/4.13b								X																		
	B.3/4.13c								X																		
4.14 Chemical Changes	C.3/4.14a											X															
	A.2/4.14b		X																								
	C.3/4.14c											X															
	A.1/4.14d	X																									
4.15 Radicals	A.3/4.15a			X																							
4.20 Chemical Reactions																											
4.21 Properties of Chemical Reactions																											
	B.1/4.21a						X																				
	B.3/4.21b								X																		
4.22 Nature of Chemical Reactions																											
	B.2/4.22a							X																			
	B.3/4.22b								X																		

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SCIENCE BEHAVIORS

		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application							Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
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4.23 Types of Chemical Reactions																											
	A.3/4.23a			X																							
	A.3/4.23b			X																							
	B.2/4.23c							X																			
4.24 Acids, Bases, and Salts	A.2/4.24a		X																								
	A.3/4.24b			X																							
	A.5/4.24c					X																					
4.30 Chemical Equations	A.1/4.30a	X																									
	A.4/4.30b				X																						
	A.4/4.30c				X																						
4.40 Chemical Laboratory Use	E.2/4.40a																			X							
	F.2/4.40b																						X				
5.00 THE NATURE OF HEAT																											
5.10 Heat and Temperature																											
5.11 Heat and Molecular Motion																											
	B.3/5.11a								X																		
5.12 Heat and Temperature	B.3/5.12a								X																		
	B.3/5.12b								X																		
5.20 Measurement of Heat and Temperature																											
5.21 Nature of Temperature	B.1/5.21a						X																				
	B.3/5.21b								X																		
	B.2/5.21c							X																			

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SCIENCE BEHAVIORS

		Cognitive																	Psycho-motor			Affective					
		Knowledge					Compre-hension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
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5.22 Measurement of																											
Temperature	B.1/5.22a						X																				
	B.1/5.22b						X																				
5.23 Measurement of Heat	A.1/5.23a	X																									
	B.1/5.23b						X																				
5.24 Specific Heat	A.5/5.24a					X																					
	B.2/5.24b							X																			
5.30 Effects of Heat on Matter	B.1/5.30a						X																				
	A.1/5.30b	X																									
	A.5/5.30c					X																					
5.40 Sources of Heat	A.2/5.40a		X																								
5.50 Heat transfer	B.3/5.50a								X																		
	A.1/5.50b	X																									
	A.2/5.50c		X																								
	A.2/5.50d		X																								
6.00 THE NATURE OF ELECTRICITY AND																											
MAGNETISM																											
6.10 Magnetism	C.3/6.10a											X															
	D.2/6.10b																X										
	B.3/6.10c								X																		
	B.2/6.10d							X																			
	B.2/6.10e							X																			
	E.2/6.10f																			X							
	B.1/6..10g						X																				

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SCIENCE BEHAVIORS

		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
		Terminology	Facts	Classification	Techniques/Procedures	Concepts/Laws/Theories	Translation to New Form	Identify Knowledge in New Context	Interpretation	Solve Math Problems	Recognize/Ident. Probl.	Observation	Measurement	Collect/Process Data	Apply Knowledge in New Situation	Formulate Hypothesis	Select Tests of Hypothesis and Procedures	Formulate Generalizations	Equipment and Techniques	Construction of Graphs, Models, Mounts, etc.	Oral Expression	Attitudes toward Science	Values, Scientific Attitudes and Methods	Enjoyment of Science	Interest in Science	Interrelationships - Sci/Humanities/Soc	Historical Background
CONTENT	OBJECTIVE	A 1	A 2	A 3	A 4	A 5	B 1	B 2	B 3	C 1	C 2	C 3	C 4	C 5	C 6	D 1	D 2	D 3	E 1	E 2	E 3	F 1	F 2	F 3	F 4	F 5	F 6
	A.5/6.10h					X																					
	A.5/6.10i					X																					
	A.5/6.10j					X																					
6.20 Electrostatics	B.3/6.20a								X																		
	B.2/6.20b							X																			
	A.2/6.20c		X																								
	D.1/6.20d															X											
	B.2/6.20e							X																			
6.30 Current Electricity																											
6.31 Current Electricity Theory																											
	D.2/6.31a																X										
	A.1/6.31b	X																									
	B.1/6.31c						X																				
6.32 Electric Circuits	C.5/6.32a													X													
	A.1/6.32b	X																									
	A.5/6.32c					X																					
	D.1/6.32d															X											
6.33 Direct and Alternating Current																											
	B.2/6.33a							X																			
6.34 Ohm's Law	A.1/6.34a	X																									
	A.5/6.34b					X																					
	E.1/6.34c																		X								
	A.4/6.34d				X																						
6.40 Energy Conversions	A.2/6.40a		X																								

PHYSICAL SCIENCE

Content/Behaviors Grid

SCIENCE BEHAVIORS

		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
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7.00 THE NATURE OF SOUND AND WAVES																											
7.10 Properties of Waves	C.3/7.10a											X															
	A.1/7.10b	X																									
	A.3/7.10c			X																							
	B.1/7.10d						X																				
	B.2/7.10e							X																			
7.20 Sound Waves																											
7.21 Sound as a wave	B.2/7.21a							X																			
	B.1/7.21b						X																				
7.22 Producing Sound	D.1/7.22a															X											
7.23 Transmitting Sound	D.2/7.23a																X										
	A.3/7.23b			X																							
7.24 Receiving Sound	A.2/7.24a		X																								
	A.2/7.24b		X																								
	B.2/7.24c							X																			
	A.3/7.24d			X																							
	B.2/7.24e							X																			
	A.2/7.24f		X																								
7.25 Sound Properties	B.3/7.25a								X																		
	B.3/7.25b								X																		
	B.2/7.25c							X																			
	B.1/7.25d						X																				
	B.1/7.25e						X																				
	A.1/7.25f	X																									

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Content/Behaviors Grid

		SCIENCE BEHAVIORS																									
		Cognitive																	Psycho-motor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
		Terminology	Facts	Classification	Techniques/Procedures	Concepts/Laws/Theories	Translation to New Form	Identify Knowledge in New Context	Interpretation	Solve Math Problems	Recognize/Ident. Probl.	Observation	Measurement	Collect/Process Data	Apply Knowledge in New Situation	Formulate Hypothesis	Select Tests of Hypothesis and Procedures	Formulate Generalizations	Equipment and Techniques	Construction of Graphs, Models, Mounts, etc.	Oral Expression	Attitudes toward Science	Values, Scientific Attitudes and Methods	Enjoyment of Science	Interest in Science	Interrelationships - Sci/Humanities/Soc	Historical Background
CONTENT	*OBJECTIVE*	A 1	A 2	A 3	A 4	A 5	B 1	B 2	B 3	C 1	C 2	C 3	C 4	C 5	C 6	D 1	D 2	D 3	E 1	E 2	E 3	F 1	F 2	F 3	F 4	F 5	F 6
	B.2/7.25g							X																			
	C.5/7.25h													X													
	A.2/7.25i		X																								
	D.2/7.25j																X										
	A.5/7.25k					X																					
	C.2/7.25l										X																
	A.5/7.25m					X																					
	A.1/7.25n	X																									
7.30 Sound Conversion	A.2/7.30a		X																								
8.00 THE NATURE OF LIGHT																											
8.10 Light Energy																											
8.11 Properties of Light	A.1/8.11a	X																									
	A.1/8.11b	X																									
	B.2/8.11c							X																			
	A.5/8.11d					X																					
	A.2/8.11e		X																								
	D.2/8.11f																X										
	B.1/8.11g						X																				
	A.2/8.11h		X																								
	B.3/8.11i								X																		
8.12 Energy Conversions	A.2/8.12a		X																								
	B.3/8.12b								X																		
	A.2/8.12c		X																								
	B.2/8.12d							X																			

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Content/Behaviors Grid

SCIENCE BEHAVIORS

		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
		Terminology	Facts	Classification	Techniques/Procedures	Concepts/Laws/Theories	Translation to New Form	Identify Knowledge in New Context	Interpretation	Solve Math Problems	Recognize/Ident. Probl.	Observation	Measurement	Collect/Process Data	Apply Knowledge in New Situation	Formulate Hypothesis	Select Tests of Hypothesis and Procedures	Formulate Generalizations	Equipment and Techniques	Construction of Graphs, Models, Mounts, etc.	Oral Expression	Attitudes toward Science	Values, Scientific Attitudes and Methods	Enjoyment of Science	Interest in Science	Interrelationships - Sci/Humanities/Soc	Historical Background
CONTENT	*OBJECTIVE*	*A 1*	*A 2*	*A 3*	*A 4*	*A 5*	*B 1*	*B 2*	*B 3*	*C 1*	*C 2*	*C 3*	*C 4*	*C 5*	*C 6*	*D 1*	*D 2*	*D 3*	*E 1*	*E 2*	*E 3*	*F 1*	*F 2*	*F 3*	*F 4*	*F 5*	*F 6*
8.20 Measurement of Light	A.1/8.20a	X																									
	A.1/8.20b	X																									
	B.2/8.20c							X																			
	A.5/8.20d					X																					
	A.2/8.20e		X																								
8.30 Reflection and Mirrors																											
8.31 Reflection	A.5/8.31a					X																					
	B.2/8.31b							X																			
8.32 Mirrors	C.5/8.32a													X													
	A.2/8.32b		X																								
8.40 Refraction and Lenses																											
8.41 Refraction	C.4/8.41a												X														
	B.3/8.41b								X																		
	A.5/8.41c					X																					
	B.3/8.41d								X																		
	B.2/8.41e							X																			
8.42 Lenses	B.1/8.42a						X																				
	B.2/8.42b							X																			
	A.5/8.42c					X																					
	A.1/8.42d	X																									
	B.2/8.42e							X																			
	A.2/8.42f		X																								
	A.2/8.42g		X																								

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SCIENCE BEHAVIORS

		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
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9.00 THE NATURE OF NUCLEAR ENERGY																											
9.10 Atomic Structure	A.2/9.10a		X																								
	A.1/9.10b	X																									
	A.1/9.10c	X																									
9.20 Radioactivity																											
9.21 Man and Radioactivity	F.6/9.21a																										X
	A.2/9.21b		X																								
	A.2/9.21c		X																								
9.22 Properties of Radiation	A.1/9.22a	X																									
	B.3/9.22b								X																		
	A.1/9.22c	X																									
9.30 Nuclear Fission																											
9.31 Uncontrollable Chain Reactions	D.2/9.31a																X										
	C.4/9.31b												X														
9.32 Nuclear Reactors	B.3/9.32a								X																		
	A.2/9.32b		X																								
9.40 Nuclear Fusion	B.2/9.40a							X																			
	D.3/9.40b																	X									
9.50 Energy Conversions	A.1/9.50a	X																									
	D.3/9.50b																	X									
	A.2/9.50c		X																								
9.60 Radioisotopes	A.4/9.60a				X																						
	F.5/9.60b																									X	

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10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES																											
10.10 Forces	B.3/10.10a								X																		
	B.2/10.10b							X																			
10.20 Measurement of Forces	C.3/10.20a											X															
10.30 Gravitation	B.2/10.30a							X																			
	C.1/10.30b									X																	
10.40 Newton's Laws of Motion																											
10.41 Inertia	A.5/10.41a					X																					
	B.3/10.41b								X																		
	B.1/10.41c						X																				
	A.2/10.41d		X																								
10.42 Speed and Acceleration	C.1/10.42a									X																	
	A.5/10.42b					X																					
	A.2/10.42c		X																								
	C.1/10.42d									X																	
	C.6/10.42e														X												
10.43 Action and Reaction	A.5/10.43a					X																					
	A.1/10.43b	X																									
	C.1/10.43c									X																	
10.50 Work	A.1/10.50a	X																									
	C.1/10.50b									X																	
	A.5/10.50c					X																					

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Content/Behaviors Grid

SCIENCE BEHAVIORS

		Cognitive																	Psychomotor			Affective					
		Knowledge					Comprehension			Application						Analysis, Synthesis			Skills			Attitude/Interest Appreciation/Value					
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10.60 Power	A.1/10.60a	X																									
	C.1/10.60b									X																	
10.70 Energy Conversions	A.2/10.70a		X																								
	A.2/10.70b		X																								

PHYSICAL SCIENCE

1.00 UNIT: THE PROCESS OF SCIENTIFIC INVESTIGATION

1.10 Topic: Means of Gathering Information

Objectives (*Minimum Objectives)	*Activities*	*References*
1.11 Using the senses		
*C.2/1.11a Given five concealed objects, the student should be able to identify correctly at least four of the objects by inference from sensory data.		
C.2/1.11b Given an observable phenomenon, the student should be able to make approximate measurements by using the five senses.		
1.12 Using Tools		
*A.4/1.12a The student should be able to list at least five instruments which aid the senses in observation.		
A.4/1.12b Given a list of tools used by scientists, the student should be able to identify at least three used by physical scientists.		
*E.1/1.12c The student should be able to demonstrate an ability in correctly identifying and using common laboratory equipment for any laboratory investigation.		
1.13 Using the Methods of Science		
*A.5/1.13a The student should be able to show knowledge of scientific observation by distinguishing between *seeing*, *observing*, and *interpreting*.		
*C.1/1.13b After conducting three teacher-selected laboratory activities, the student should be able to state that any means of obtaining information has its own limitations.		
*A.3/1.13c Given a list of ways to gather information, the student should be able to identify the methods which are scientific and those which are nonscientific.		

PHYSICAL SCIENCE

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.10 Means of Gathering Information

Subtopic/Specification/Objective Number *Test Item*

1.11 Using the Senses

C.2/1.11a

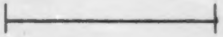
1. On the demonstration desk are five sealed boxes. Choose any four. List five things you detect about the object concealed inside, and tell what you think the object is.

2. You have been given five boxes containing concealed objects. You have guessed the boxes to contain the objects listed below. Indicate which sense or senses you used to identify the objects.
   A. onion
   B. BB's
   C. water in a plastic bag
   D. moth balls
   E. toothpicks

C.2/1.11b

1. You have been given five tubes containing blue ink in water. Tube A has two drops of ink, B has four drops, C has six drops, and D has eight drops. By matching up the colors, how many drops of ink do you think are in tube E?

2. The length of this line is about____centimeters long.



3. Choose a partner, preferably someone with a watch with a second hand. Close your eyes and try to estimate when a minute of time has passed.

1.12 Using Tools

A.4/1.12a

1. List five instruments which help your senses in observing.

A.4/1.12b

1. In the list below, check (√) those tools which would most likely be used by a physical scientist.

A. ruler	E. graduated cylinder
B. meter stick	F. test tube
C. beaker	G. bathroom scale
D. microscope	

PHYSICAL SCIENCE

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.10 Means of Gathering Information

Subtopic/Specification/Objective Number — *Test Item*

E.1/1.12c

1. TEACHER SELECTED DIAGRAMS. The teacher should have on hand appropriate pictures of various pieces of common laboratory apparatus. The student should be asked to "Identify at least_____ of the pieces of laboratory equipment shown."

2. TEACHER SELECTED APPARATUS. The teacher should have pieces of common laboratory equipment in one central location. The student should be asked to identify, orally or in writing, a certain number of these pieces.

1.13 Using the Methods of Science

A.5/1.13a

1. TRUE OR FALSE. In science, seeing means the same thing as observing.

2. _____involves mainly the power of vision.
   _____is the act of paying close attention to the details of an object.
   _____is an explanation of what has occurred.

3. Sugar dissolves faster in hot water. Is this an *observation*, or an *interpretation?* Explain your answer.

C.1/1.13b

1. TRUE OR FALSE. There are limiting factors or conditions on most experiments.

A.3/1.13c

1. From our class discussions we know that a scientist has a guide involving several steps which he uses when making an investigation. In the space provided, list five ways he may gather his data. Denote whether each is scientific or non-scientific.

2. Place a check mark (✓) beside those means of gathering information below that are scientific:
   A. Reading a book
   B. Watching something happen
   C. Repeating an investigation
   D. Thinking about something, until you have the answer
   E. Accepting something, because you know it is true
   F. Gathering information

PHYSICAL SCIENCE

1.00 UNIT: THE PROCESS OF SCIENTIFIC INVESTIGATION

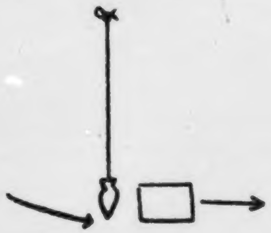
1.20 Topic: Controlled Experiments

Objectives	(*Minimum Objectives)	*Activities*	*References*
*A.4/1.20a	After conducting a controlled experiment, the student should be able to select the control, the dependent and independent variables, the conclusion and any limiting factors.		
*F.2/1.20b	The student should be able to demonstrate an understanding of the scientific process by applying the general steps used by scientists in a laboratory investigation.		
*F.2/1.20c	The student should be able to demonstrate a knowledge that orderly, accurate records are necessary for valid and meaningful investigations by keeping orderly, accurate records of his own laboratory investigations.		
D.1/1.20d	Given a teacher-prepared laboratory procedure, the student should be able to conduct a controlled investigation which contains at least one controlled variable, record the data, and state a conclusion.		

PHYSICAL SCIENCE

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.20 Controlled Experiments

Subtopic/Specification/Objective Number	*Test Item*
A.4 /1.20a	1. In the diagram at right, a 500g swinging bob moves the block an average of 33 cm. A 200g swinging bob moves the same block an average of 16 cm. Name the *dependent variable, independent variable,* and state a *conclusion.* 2. *"Our group had 33 percent fewer cavities."* Name the *control, dependent variable, independent variable,* and *conclusion* in this experiment. 
F.2 /1.20b	1. Using the following items as a basic wardrobe, take $200.00 and complete a school wardrobe for the year. Use the scientific method and identify the steps. Work out a seven-day attire schedule. 3 skirts/pants 2 pair dungarees 4 T-shirts 5 pair socks/pantyhose necessary underclothes 2. Students may identify the steps in the Scientific method to the filmstrip *The Story of Dr. Lister* and/or *The Mystery of the Cosmic Rays.*
F.2 /1.20c	Evaluated by periodic teacher observation.
D.1 /1.20d	Evaluated by periodic teacher observation.

PHYSICAL SCIENCE

1.00 UNIT: THE PROCESS OF SCIENTIFIC INVESTIGATION

1.30 Topic: Measurement

Objectives	(*Minimum Objectives)	*Activities*	*References*
1.31 Measurement Systems			
*B.3/1.31a	The student should be able to state that there is a need for a standard system of measurement by devising his own system of linear measurement and by comparing his system with those of other class members.		
*C.2/1.31b	After doing a laboratory investigation involving measurement, the student should be able to state that variations in measurements are due to human errors and limitations of measuring devices.		
B.2/1.31c	The student should be able to show an awareness of the difference between the metric system and the English system by measuring the length and width of an object using an English ruler and a metric ruler.		
1.32 The Metric System			
*A.4/1.32a	Following class discussion, the student should be able to identify the basic metric unit that is used for measuring each of the following: (1) length, (2) weight, (3) volume, and (4) temperature.		
*A.4/1.32b	The student should be able to define each of the prefixes used to indicate different units of measure in the metric system: milli-, centi-, deci-, and kilo-.		
*B.1/1.32c	Given a measure of length, volume, or weight in any metric unit, the student should be able to convert the measure to any other metric unit of length, volume, or weight.		

1.00 UNIT: THE PROCESS OF SCIENTIFIC INVESTIGATION
1.30 Topic: Measurement

Objectives	*(*Minimum Objectives)*	*Activities*	*References*
1.33 Length Measurement			
*C.4 /1.33a	Following class discussion, the student should be able to measure the length of objects in metric units to 0.1 centimeter.		
1.34 Volume Measurement			
*C.4 /1.34a	Following class discussion, the student should be able to measure the volume of solids and liquids in metric units to 0.1 milliliter [or 0.1 cm^3].		
1.35 Weight Measurement			
*C.4 /1.35a	Following class discussion, the student should be able to determine the weights of an object in metric units to 0.1 gram.		
1.36 Temperature Measurement			
*C.4 /1.36a	Following class discussion, the student shoud be able to measure temperatures to within 1°c.		
1.37 Significant Figures			
*C.1 /1.37a	Given a number less than 100,000, the student should be able to demonstrate a knowledge of significant figures by expressing the number to three significant figures.		
1.38 Graphing			
*E.2 /1.38a	Given the results of a laboratory investigation, the student should be able to record the results and display them in tabular and graphic form.		
*B.1 /1.38b	Given the results of a laboratory investigation in graphic form, the student should be able to describe the factual		

PHYSICAL SCIENCE

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.30 Measurement

Subtopic/Specification/Objective Number	*Test Item*
1.31 Measurement Systems	
B.3/1.31a	1. Measure the length and width of your room without using a meter stick or a ruler. Compare your results with your classmates. What does this tell you about the requirements of a good measuring system? 2. After measuring various objects using your own measuring system, what, in your opinion, are the qualities that a good measuring system should have?
C.2/1.31b	1. Complete the following statement: Variations in measurements are due to_____and_____. 2. What is meant by the statement, "All measurements are estimates."?
B.2/1.31c	1. Measure the length, width, and height of your book, using (1) the English scale, in inches, and (2) the metric scale, in centimeters. Now find the volume of your book in both scales. Convert the volume of your book to ft^3 and meters^3. What does this tell you about the nature of both systems of measurement?
1.32 The Metric System	
A.4/1.32a	1. The unit of length in the metric system is_____. The unit of volume in the metric system is_____. The unit of weight [mass] in the metric system is _____. 2. If you were going to measure the width of a table, which of the following units would you use for your answer? (a) grams (b) centimeters (c) milliliters 3. If you were measuring the amount of water in a graduated cylinder, which of the following units would you use for your answer? (a) grams (b) centimeters (c) milliliters

Continued on next page.

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.30 Measurement

Subtopic/Specification/Objective Number *Test Item*

4. The most convenient unit for measuring the distance between two cities is the
   (a) millimeter
   (b) Kilometer
   (c) gram
   (d) centimeter

1.32 The Metric System

A.4/1.32b

1. List the following from smallest to largest:
   A. meter, Kilometer, decimeter, decameter
   B. centigram, gram, milligram, Kilogram

2. Which of the following prefixes means 1/10?
   (a) centi-
   (b) milli-
   (c) deci-
   (d) deca-

3. Complete the following items:
   A. The prefix *deci* means_____.
   B. The prefix *centi* means_____.
   C. The prefix *milli* means_____.
   D. The prefix *Kilo* means_____.

4. Match the prefixes to their correct values:
   1. deci
   2. deca
   3. micro
   4. mega
   5. Kilo
   6. centi
   7. milli
   8. hecto

   a. 100
   b. 1/100
   c. 1,000
   d. 1,000,000
   e. 1/10
   f. 1/1,000,000
   g. 10
   h. 1/1,000

Continued on next page.

PHYSICAL SCIENCE

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.30 Measurement

Subtopic/Specification/Objective Number — *Test Item*

5. Fill in the blanks:
   A. Milli means_____.
   B. 1 Kilogram has _____grams in it.

B.1/1.32c

1. Make the following conversions:
   .01 meter=_____centimeters
   1576 meters = _____Kilometers
   698 grams = _____milligrams
   15 decimeters = _____millimeters
   180 decimeters = _____Kilometers
   5 Kilograms = _____milligrams
   2.5 milliliters = _____cubic centimeters
   2 centimeters = _____meters
   3.167 millimeters = _____decimeters

2. What is the relationship between ml and cm^3(cc)?

3. A millimeter is _____of a meter.
   A centimeter is_____of a meter.
   A decimeter is _____ of a meter.

4. Convert to liters:
   89 deciliters
   965 centiliters
   10 milliliters
   3000 centiliters
   9 Kiloliters

5. What are the names of the following units?
   0.1 meter = _____
   0.01 meter = _____
   0.001 meter = _____

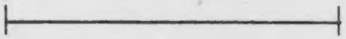
1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.30 Measurement

Subtopic/Specification/Objective Number *Test Item*

1.33 Length Measurement

C.4/1.33a

1. Measure the length of this line to the nearest 0.1 cm: 

2. Measure the length and width of this test paper to the nearest 0.1 centimeter.

3. Measure the length of your book to the nearest 0.1 centimeter.

4. Measure the length of your desk to the nearest 0.1 centimeter.

1.34 Volume Measurement

C.4/1.34a

1. A box has a height of 5 cm, a length of 10 cm and a width of 8 cm. The volume occupied by the box would be
   (a) 80 cm
   (b) 800 cm^3
   (c) 400 cm
   (d) 400 cm^3

2. The water level in a graduated cylinder is at the 25.5 ml line. You drop a marble in the water and the water level moves to the 28.5 ml line. The volume of the marble is
   (a) 28.5 ml
   (b) 25.5 ml
   (c) 3.0 ml
   (d) 3.5 ml

3. An object has three sides measuring 3.0 cm long. The volume of the box is_____.

1.35 Weight Measurement

C.4/1.35a

1. Using the balance provided, weigh your book to the nearest 0.1 gram.

1.36 Temperature Measurement

C.4/1.36a

1. Using the thermometer provided, measure the temperature of the water in the beaker on the lab table to the nearest degree.

PHYSICAL SCIENCE

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION

1.30 Measurement

Subtopic/Specification/Objective Number — *Test Item*

1.37 Significant Figures

C.1/1.37a

1. You have a measuring stick that is marked off in millimeters. Which of the following measurements is the most accurate, from that ruler?
   (a) 0.001 cm
   (b) 0.1 cm
   (c) 1 cm
   (d) 1.00 cm

2. Convert to scientific notation:
   1000
   1,000,000
   .00001
   1.00
   45.6

3. Rewrite the following without using scientific notation:
   6.0×10^{-4}
   4.3×10^{5}
   3.89×10^{-2}

1.38 Graphing

E.2/1.38a

1. Plot the following data on a line graph:
   2 cm = 2
   6 cm = 12
   8 cm = 20
   10 cm = 23

Continued on next page.

1.00 THE PROCESS OF SCIENTIFIC INVESTIGATION
1.30 Measurement

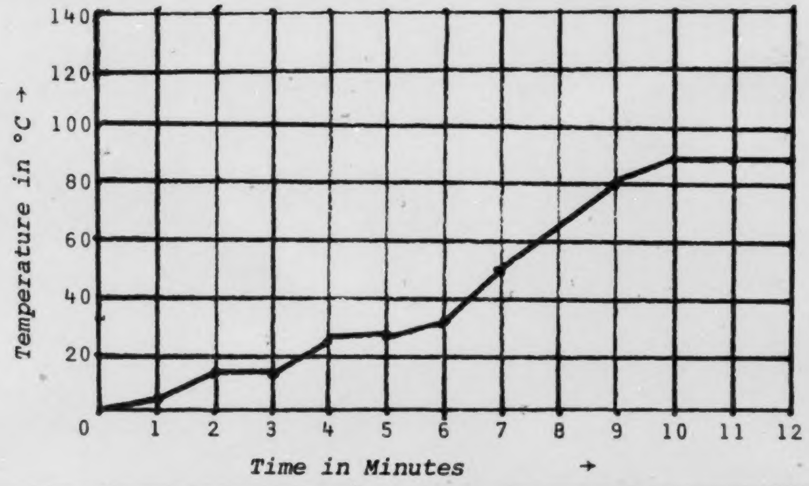
Subtopic/Specification/Objective Number	*Test Item*
	2. Graph the following information:

Grams	*Beans*
7.0	2
10.0	4
15.0	6
22.0	8
38.0	14
39.9	16
47.8	18
57.3	22
62.3	24
67.8	26

B.1/1.38b [*Based on the graph of 1.38a, Item 2, above*]

1. How many beans are in 12 grams?
   How many beans are in 10 grams?
   Using the graphed average, how many beans equal one gram?
   How many beans equal 250 grams?
   How many grams equal 250 beans?

2. The items below are based on the following graph:



1. After one minute of heating the temperature is_____.
2. Is there a temperature change between 10 and 12 minutes?
3. How much does the temperature increase between 4 and 5 minutes?
4. Between 7 and 8 minutes the temperature rise _____degrees.

PHYSICAL SCIENCE

2.00 UNIT: THE NATURE OF ENERGY

2.10 Topic: Sources of Energy

Objectives	(*Minimum Objectives)	*Activities*	*References*
*A.1/2.10a	After doing a brief laboratory activity involving energy classification and changes, the student should be able to define the terms *energy, potential energy,* and *kinetic energy.*		
A.3/2.10b	After completing a reading assignment or laboratory activity, the student should be able to list at least five forms of energy.		
*B.2/2.10c	The student should be able to give five examples to show that much of the energy used by man comes ultimately from the sun.		
B.3/2.10d	After class discussion of the source of energy in the sun and the earth, the student should be able to conclude that energy in nature is one quantity.		

PHYSICAL SCIENCE

2.00 THE NATURE OF ENERGY

2.10 Sources of Energy

Subtopic/Specification/Objective Number — *Test Item*

A.1/2.10a

1. Define the following terms:
   energy--
   potential energy--
   kinetic energy--

2. The ability to do work is_____.
   _____energy is stored energy.
   _____energy is energy in motion.

3. Energy of motion is
   (a) matter.
   (b) kinetic energy.
   (c) potential energy.

4. Energy at rest, or stored, is
   (a) matter.
   (b) kinetic energy.
   (c) potential energy.

A.3/2.10b

1. List at least five forms of energy.

B.2/2.10c

1. Place a check mark (✓)beside those examples of energy from the sun.
   ___plants making food in the presence of sunlight.
   ___the movement of a radiometer.
   ___the burning of coal, which comes from the fossil remains of plants.
   ___electricity from a generator by a dam, from a lake filled by rainwater, which was produced from evaporation.

2. List five different examples of the conversion of energy, and trace the conversion back to its ultimate source.

3. The energy of most things on earth can be traced back to_____.

4. The ultimate source of our energy here in Norfolk is:
   (a) coal.
   (b) electricity.
   (c) the sun.
   (d) water power.

2.00 THE NATURE OF ENERGY

2.10 Sources of Energy

Subtopic/Specification/Objective Number	*Test Item*
B.3/2.10d	1. Energy is (a) either potential or kinetic. (b) something that can be changed into many different forms. (c) really only one quantity. (d) none of the above are correct. (e) all of the above are correct. 2. TRUE OR FALSE. Energy is a general term for many different things that are separate from one another.

PHYSICAL SCIENCE

2.00 UNIT: THE NATURE OF ENERGY

2.20 Topic: Forms of Energy

Objectives (*Minimum Objectives)		*Activities*	*References*
*A.3/2.20a	From a given list of common objects, the student should be able to identify at least 90% of those that are in a state of potential energy and those that are in a state of kinetic energy.		
*A.3/2.20b	Based on experimental data and class discussion, the student should be able to name five forms of energy and to give one example of each form. *NOTE: See Objective 2.10b.*		
*A.3/2.20c	The student should be able to demonstrate an understanding of the energy forms that different objects have or use that makes it possible for them to cause a change of motion, by (1) identifying the form of energy [mechanical, chemical, etc.] and/or (2) the state of energy [potential or kinetic].		

PHYSICAL SCIENCE

2.00 THE NATURE OF ENERGY

2.20 Forms of Energy

Subtopic/Specification/Objective Number — *Test Item*

A.3/2.20a

1. Put a P (for Potential) or a K (for kinetic) for the types of energy in each example below:
   a rolling ball
   food
   a muscle being flexed
   a parked car
   a running man
   gasoline in a car
   a moving car
   wound watch spring
   an electric light turned on
   standing still
   water behind a dam
   an upraised hammer
   stretched rubber band

2. In the examples of energy found in a car below, place a P (for potential) or a K(for kinetic) next to each example.
   Gasoline in the tank.
   Burning gasoline in the cylinder.
   Piston motion.
   Drive shaft turning.
   Axle turning.
   Wheel turning.

3. In the examples of energy changes in an electricity generating plant, place a P (for potential) or a K (for kinetic) next to each example.
   Water behind a dam.
   Water running down through the dam.
   Water hitting the turbine wheel.
   The turbine wheel turning.
   Electricity from the generator attached to the turbine.

2.00 THE NATURE OF ENERGY

2.20 Forms of Energy

Subtopic/Specification/Objective Number	*Test Item*
A.3/2.20b	1. Name five forms of energy and give an example of each form.
A.3/2.20c	1. Classify each of the following as to *type* (mechanical, etc.) and *form* (potential or kinetic). A ton of coal A moving tractor Light from the sun A piece of dynamite A loud noise An electric line, 120v

PHYSICAL SCIENCE

2.00 UNIT: THE NATURE OF ENERGY

2.30 Topic: Transfer of Energy

Objectives (*Minimum Objective)		*Activities*	*References*
*B.2/2.30a	The student should be able to demonstrate a knowledge of potential energy and kinetic energy by explaining energy conversions that occur during the motion of a pendulum.		
A.3/2.30b	Given a series of environmental phenomena, the student should be able to classify with 80% accuracy those conditions according to kinetic or potential energy.		

PHYSICAL SCIENCE

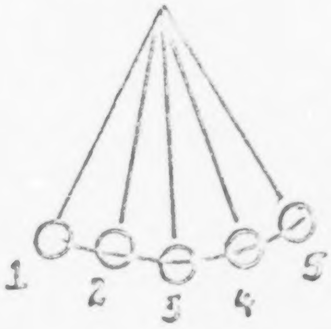
2.00 THE NATURE OF ENERGY
2.30 Transfer of Energy

Subtopic/Specifications/Objective Number *Test Item*

B.2/2.30a

1. A swinging pendulum goes through several changes of energy. State the energy changes that a pendulum undergoes, and state where in the swing these changes occur.

2. In the diagram at right, which number(s) represent the points at which the pendulum has potential energy but no kinetic energy?
Which number represents the point at which the pendulum has the most kinetic energy?
Which number(s) represent the point at which the pendulum has both potential and kinetic energy?



A.3/2.30b

1. Kinetic energy is best expressed by
   (a) a ball on top of a hill.
   (b) sugar in our muscles.
   (c) water in a dam.
   (d) a falling rock.

2. Place a P (for potential) or a K (for kinetic) next to these examples of energy found in the environment.
   Walking up stairs.
   A light switch in the OFF position.
   Wind blowing.
   A thundercloud building up.
   Turning on a sink faucet.
   A book lying on a table.
   An open door with a closing spring attached.
   Oxygen in the air.
   The sound of thunder.
   Water boiling on a stove.

PHYSICAL SCIENCE

2.00 UNIT: THE NATURE OF ENERGY

2.40 Topic: Transformation of Energy

Objectives	(*Minimum Objectives)	Activities	References
2.41 Transformation of Energy			
*B.2/2.41a	Based on experimental data, the student should be able to give five examples of the transformation of energy from one form to another.		
B.2/2.41b	Given a description of an energy change, the student should be able to explain whether it has been a transformation in the form or the state of energy, and/or name the form or state to which it has been changed.		
2.42 Energy Chains			
D.3/2.42a	Based on the class discussion and observation of a natural phenomena, the student should be able to give three examples of energy chains, describing the energy changes that occur in each.		
2.43 Use of Energy Transformations			
*F.1/2.43a	Based on class discussion and personal opinion, the student should be able to explain how learning about energy transformations has benefited man.		
*B.2/2.43b	To encourage students to recognize the **changes** between kinetic and potential energy, **the st**udent should be able to list and describe at least two energy changes involved in their daily lives.		

2.00 UNIT: THE NATURE OF ENERGY

2.40 Topic: Transformation of Energy

Objectives (*Minimum Objectives)		*Activities*	*References*
2.44 Law of Conservation of Mass-Energy			
*D.2/2.44a	After performing a laboratory investigation for the transformation of energy, the student should be able to state the law of conservation of energy and the law of conservation of mass-energy.		
C.6/2.44b	The student should be able to apply the law of conservation of mass-energy by stating that energy in the sun is produced by nuclear fusion (conversion of some mass to energy).		
B.2/2.44c	The student should be able to apply the law of conservation of energy by listing and describing five conversions of the sun's energy that occur on the earth.		

PHYSICAL SCIENCE

2.00 THE NATURE OF ENERGY

2.40 Transformation of Energy

Subtopic/Specification/Content Number *Test Item*

2.41 Transformation of Energy

B.2/2.41a

1. Some examples are given below of the transformation of one form of energy into another. Tell what the energy was in its original form, and what it became.
   Burning coal
   A turning car generator
   A car storage battery
   Electricity running through the wire of a lamp bulb

2. Match the items in the left column with two kinds of energy from the right column. Tell what the energy was, and what it became.

_____to_____pendulum moving from top to bottom of swing
_____to_____heating wire by bending it
_____to_____electric light
_____to_____steam turbine wheel
_____to_____fuel cell
_____to_____energy from the sun

a. chemical
b. electrical and/or magnetic
c. heat
d. kinetic
e. mechanical
f. nuclear
g. potential
h. radiant

3. Give five examples of the conversion of one form of energy to another. Tell the form of the energy being converted, and the form it is converted to.

4. A motor changes _____energy into_____energy.
   A toaster changes _____energy into_____energy.
   A car changes_____to_____energy.
   A solar cell changes_____energy to_____energy.
   A running man changes_____energy into_____energy.

5. A dry cell changes
   (a) motion into energy
   (b) light into heat
   (c) chemical energy into electrical
   (d) mechanical energy into work

2.00 THE NATURE OF ENERGY

2.40 Transformation of Energy

Subtopic/Specification/Content Number	*Test Item*
B.2/2.41b	1. Suzie throws mashed potatoes on the floor. What is the form, or type, of energy transformation that has taken place? Explain your answer. 2. A piece of dynamite explodes. (a) What, if any, change in the *form* of energy has occurred? Explain. (b) What, if any, change in the *type* of energy has occurred? Explain.
2.42 Energy Chains	
D.3/2.42a	1. Give three examples of energy chains that occur in nature, and list the energy changes that occur in each. 2. Pick any three of the examples below, and list the energy changes that occur in each. sugar from plant photosynthesis from water in a dam to a light bulb from gasoline to a moving car from a plant to a moving human body from coal in a generating plant to a turning electric motor
2.43 Use of Energy Transformations	
F.1/2.43a	1. Explain how at least two energy transformations have benefitted man.
B.2/2.43b	1. List and describe at least two energy changes (kinetic and potential energy) that occur in your daily life.

PHYSICAL SCIENCE

2.00 THE NATURE OF ENERGY

2.40 Transformation of Energy

Suptoic/Specification/Content Number	*Test Item*
2.44 Law of Conservation of Mass-Energy	
D.2/2.44a	1. The Law of Conservation of Energy states_____. The Law of Conservation of Mass-Energy states_____. 2. TRUE OR FALSE. According to the Law of Conservations of Mass-Energy, matter and energy cannot be created nor destroyed, only changed into each other.
C.6/2.44b	1. Explain how the Law of Conservation of Mass-Energy applies to the sun.
B.2/2.44c	1. List and describe five conversions of the sun's energy that occur on the earth.

PHYSICAL SCIENCE

3.00 UNIT: THE NATURE OF MATTER

3.10 Topic: General Properties of Matter

Objectives (*Minimum Objectives)		*Activities*	*References*
3.11 Mass			
*C.3/3.11a	The student should be able to demonstrate an ability to determine the mass of an object by properly using a balance and by correctly determining the mass of five objects to the nearest 0.1 g.		
*A.1/3.11b	Based on experimental data, the student should be able to define correctly the term *mass*.		
*A.5/3.11c	Based on class discussion and experimental data, the student should be able to compare and contrast mass and weight.		
3.12 Inertia			
*A.1/3.12a	After performing a laboratory investigation, the student should be able to state the definition for *inertia*.		
*B.2/3.12b	Based on experimental data, the student should be able to make a concluding statement about the relationship between mass and inertia.		
3.13 Volume			
*C.3/3.13a	The student should be able to demonstrate an ability to determine the volume of a substance in the following ways: (1) by using a graduated cylinder and measuring to the nearest 1.0 ml, (2) by using a metric ruler and determining the volume to the nearest 0.1 cm^3, and (3) by using the water displacement method and determining the volume to the nearest 1.0 ml.		

3.00 UNIT: THE NATURE OF MATTER

3.10 Topic: General Properties of Matter

Objectives	(*Minimum Objectives)	*Activities*	*References*
*A.1/3.13b	Based on experimental data, the student should be able to define the term *volume*.		
3.14 Density and Specific Gravity			
*A.1/3.14a	Following a laboratory investigation, the student should be able to define density in terms of mass (or weight) and volume.		
*C.6/3.14b	The student should be able to demonstrate an understanding of the concept of density by correctly arranging five familiar items in order of ascending or descending densities.		
C.1/3.14c	Given the formula $Dm=m/v$ (or $Dw=w/v$), the student should be able to solve correctly for the unknown in 4 out of 5 density problems.		
*A.5/3.14d	Following a laboratory investigation on specific gravity, the student should be able to conclude that specific gravity is the relative density of an object compared to a standard.		
3.15 The Molecular Theory			
*A.5/3.15a	Following a laboratory investigation on molecular attraction, the student should be able to compare and contrast *adhesion* and *cohesion*, including a definition and an example of each term.		
*B.2/3.15b	After performing at least two laboratory activities to illustrate the molecular theory of matter, the student should be able to state that matter is made up of constantly moving particles with spaces between them.		

PHYSICAL SCIENCE

3.00 UNIT: THE NATURE OF MATTER

3.10 Topic: General Properties of Matter

Objectives (*Minimu Objectives)	*Activities*	*References*
*C.6/3.15c After several laboratory investigations, students will apply the principles of the molecular theory to the behavior of matter under various conditions.		

3.00 THE NATURE OF MATTER

3.10 General Properties of Matter

Subtopic/Specification/Content Number	*Test Item*

3.14 Density and Specific Gravity

A.1/3.14a

1. What is meant by the term *density?*

2. The mass/volume ratio of a substance is called_____.

3. Density is measured in
   (a) g/ml
   (b) ℓ/Kg
   (c) g/ft^3
   (d) lb/l

C.6/3.14b

Evaluated by teacher observation of performance.

C.1/3.14c

1. What is the density of an object that has a mass of 5 grams and a volume of 10 ml?

2. The density of an object that weighs 80 grams and has a volume of 20 ml is
   (a) 160 g/ml
   (b) 4 g/ml
   (c) 40 g/ml
   (d) 80 g/ml

3. An object has a volume of 5 ft^3. It weighs 25 pounds. What is its density?

4. What is the density of an object that has a volume of 360 ml and a mass of 120 grams?

5. Find the density of an object that has a volume of 25 ml and a weight of 10 grams.

3.00 THE NATURE OF MATTER

3.10 General Properties of Matter

Subtopic/Specification/Content Number — *Test Item*

3.11 Mass

C.3/3.11a

1. Evaluated by teacher observation of operation.

A.1/3.11b

1. What is meant by the term *mass?*

2. *Mass* is
   (a) the weight of an object.
   (b) the energy that an object has.
   (c) the amount of matter in an object.
   (d) the strength of the pull of gravity on an object.

A.5/3.11c

1. How are *mass* and *weight* similar? How are they different?

2. Beside each of the following, write (M) if it is a characteristic of mass and (W) if it is a characteristic of weight, and (B) if it is a characteristic of both.
   _____determined by the amount of matter in a body.
   _____not affected by the force of gravity.
   _____changes as the force of gravity changes.
   _____disappears if there is no gravity.

3. The weight of an object will
   (a) not change.
   (b) increase on the moon.
   (c) decrease on the moon.
   (d) disappear on Jupiter.

4. The mass of an object will
   (a) not change.
   (b) increase on the moon.
   (c) decrease on the moon.
   (d) disappear on Jupiter.

PHYSICAL SCIENCE

3.00 THE NATURE OF MATTER

3.10 General Properties of Matter

Suptoic/Specification/Content Number — *Test Items*

3.12 Inertia

A.1/3.12a

1. What is the meaning of the term *inertia?*

2. TRUE OR FALSE
Inertia deals with the motion and mass of an object.

3. The force that keeps moving objects in motion and tends to keep still objects at rest is
(a) friction.
(b) mass.
(c) weight.
(d) inertia.

B.2/3.12b

1. What is the relationship between *mass* and *inertia?*

2. The relationship of inertia to mass is
(a) both change as gravity changes.
(b) inertia becomes greater as mass becomes less.
(c) mass becomes greater with less inertia.
(d) inertia and mass increase at the same rate.

3.13 Volume

C.3/3.13a

Measured by teacher observation of student performance.

/3.13b

1. What is meant by the term *volume?*

2. Volume depends on
(a) the amount of space.
(b) the amount of weight.
(c) the inertia of an object.

3. Volume is measured in
(a) inches.
(b) cm^3
(c) cm^2
(d) ft^2

3.00 THE NATURE OF MATTER

3.10 General Properties of Matter

Subtopic/Specification/Content Number	*Test Item*
A.5/3.14d	1. What is meant by the term *specific gravity?*
	2. The relationship of density to a standard is called_____.
	3. *Specific Gravity* is (a) the density of an object. (b) the mass/volume ratio of an object. (c) the comparision of the density of an object to a standard. (d) the comparision of the density of an object to the mass/volume ratio of the object.

3.15 The Molecular Theory

Subtopic/Specification/Content Number	*Test Item*
A.5/3.15a	1. The attraction of molecules for each other is called___. The attraction of molecules for other, unlike molecules is called_____.
	2. What is *adhesion?* Give an example of adhesion. What is *cohesion?* Give an example of cohesion.
B.2/3.15b	1. Using complete sentences, state the molecular theory of matter.
C.6/3.15c	1. Water soaks through a piece of blotting paper, and spreads over a wide area. But water stands up in a tight ball on wax paper. Explain, using the molecular theory of matter.
	2. 100 ml of water and 100 ml of alcohol are poured together. Their total volume is only 198 ml. Explain, using the molecular theory of matter.
	3. 100 ml of oil is heavier than 100 ml of water. Explain, using the molecular theory.
	4. You can tear a piece of paper into smaller and smaller pieces, but you still have paper. But if you add certain chemicals to the paper and heat it, it breaks down into other substances. Explain, using the molecular theory.

PHYSICAL SCIENCE

3.00 UNIT: THE NATURE OF MATTER

3.20 Topic: The States of Matter

Objectives	(*Minimum Objectives)	*Activities*	*References*
3.21 The Molecular Theory			
B.3/3.21a	Following teacher-conducted demonstrations of the motion of molecules in a fluid, the student should be able to describe the phenomenon of Brownian Movement.		
D.3/3.21b	Based on class discussion and laboratory investigation, the student should be able to explain the relative motion of the molecules and the relative distance between the molecules of solids, liquids, and gases.		
*A.5/3.21c	The student should be able to describe the term *diffusion* by giving an explanation of the term and describing a demonstration illustrating the term.		
3.22 Properties of Solids, Liquids, and Gases			
*A.3/3.22a	Given a list of at least 15 common substances, the student should be able to classify each one as being solid, liquid, or gas.		
*A.5/3.22b	The student should be able to apply his knowledge of the three states of matter by identifying with 90% accuracy when a change of state has occurred in at least five situations.		
*B.2/3.22c	Based on a laboratory investigation (such as ice to water to steam), the student will be able to construct a graph of the energy changes involved in **changes** of states of matter.		
D.1/3.22d	The student should be able to demonstrate knowledge of the meaning of the terms "freezing point" and "boiling point" by devising an experiment to illustrate both terms.		
*A.2/3.22e	Following laboratory investigation, the student should be able to list at least two properties each of solids, liquids, and gases.		

3.00 UNIT: THE NATURE OF MATTER

3.20 Topic: The States of Matter

Objectives	(*Minimum Objectives)	*Activities*	*References*
3.23 Sublimation			
A.1/3.23a	Following class discussion on sublimation, the student should be able to define the term *sublimation*, and name at least two substances that sublimate.		
3.24 Solids			
*C.6/3.24a	The student should be able to explain the principle of floatation by using the concepts of density and buoyancy (Archimede's Principle) to explain why an object will float or sink.		
3.25 Liquids			
*A.1/3.25a	After laboratory investigation, the student should be able to state and give at least three examples of the meaning of capillarity.		
*A.1/3.25b	After class discussion, the student should be able to define the term *fluid*, and list at least two properties of fluids.		
3.26 Gases			
*B.3/3.26a	Following class discussion, the student should be able to compare and contrast Charle's Law and Boyle's Law.		
3.27 Plasma			
A.1/3.27a	The student should be able to define the term *plasma* and list at least five properties of plasma (relative speed of plasma particles, temperature and plasma, energy in plasma, properties of plasma particles, and at least five conditions under which plasma is found.).		

3.00 THE NATURE OF MATTER

3.20 The State of Matter

Subtopic/Specification/Content Number *Test Item*

3.21 The Molecular Theory

B.3/3.21a

1. Describe what is meant by *Brownian Movement*.

2. What do the following two demonstrations describe?
   A. Glass particles jump and hit each other when the tube they are in is heated.
   B. Small drops of milk particles wiggle across a glass slide under a microscope.

D.3/3.21b

1. According to the molecular theory, describe (1) the speed of the molecules, and (2) the distance between molecules, for
   A. solids.
   B. liquids.
   C. gases.

2. Draw a picture of the molecules in solids, liquids, and gases. Indicate how far apart they are, and indicate their relative speeds by drawing long arrows for fast speed and short arrows for slow speed.

3. Place an S (for solid), L (for liquid), **or** a G (for gas), for each of the properties of molecules listed below:
   _____slow-moving molecules
   _____medium-speed molecules
   _____fast molecules
   _____molecules very far apart, little attraction
   _____molecules very close together, held strongly by attractive forces
   _____molecules separated and fairly free-moving, but held by attractive forces

A.5/3.21c

1. Tell what is meant by the term *diffusion*, and give an example of diffusion at work.

2. Two blocks of different metals are placed tightly together. After a long period of time, the two blocks cannot be separated, and molecules of one metal are found in the other block. What property of matter is being illustrated here?

3.00 THE NATURE OF MATTER

3.20 The States of Matter

Subtopic/Specification/Content Number	*Test Item*

3.22 Properties of Solids, Liquids, and Gases

A.3/3.22a Place an S (for solid, L (for liquid), or a G (for gas), in the space provided by the substances below:

_____ice
_____flowing lava
_____steam
_____paper
_____cleaning fluid
_____air
_____gasoline
_____ammonia fumes
_____rubber
_____a bar of soap
_____coal
_____water
_____steel
_____glass
_____iodine vapor

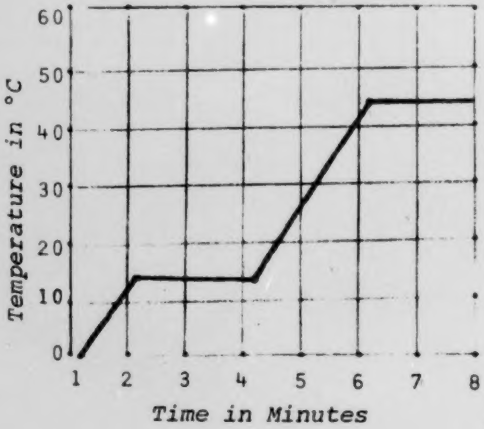
A.5/3.22b For each of the changes below, indicate if a change of state has occurred. If one has, tell the starting state and the ending state.

A. wood ground up into sawdust.
B. Ice melts.
C. Iron pellets heated in a blast furnace and poured out.
D. Water boils.
E. Paper is cut into small pieces.

B.2/3.22c Evaluated by teacher observation of student-conducted lab investigation.

D.1/3.22d 1. How would you go about finding the freezing and boiling points of an unknown substance? Devise an investigation that would give you these values, and tell how you would know when the freezing and boiling points had been reached.

2. Look at the graph on the right. What property of matter is being illustrated here? How was the data for the graph obtained (describe an investigation that would produce the graph)? Mark and explain any especially significant places on the graph line.



3.00 THE NATURE OF MATTER
3.20 The States of Matter

Subtopic/Specification/Content Number *Test Item*

A.2/3.22e List at least two properties for each of the following states of matter:

A. solids
B. liquids
C. gases

3.23 Sublimation

A.1/3.23a Define the term *sublimation*, and name at least two substances that sublimate.

3.24 Solids

C.6/3.24a 1. A piece of rock and a piece of wood are dropped in a beaker of water. Explain:

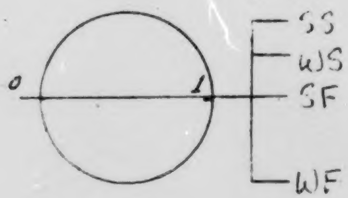
A. What will happen to the water level in each case.
B. Why one sinks.
C. Why one floats.

2. Objects that sink in water have a density

(a) of less than 1 g/ml.
(b) equal to 1 g/ml.
(c) greater than 1 g/ml.
(d) equal to zero.

3. Iron sinks. Explain why an iron ship can float.

4. Ships have markings on their sides called *Plimsol Lines*. An example of a Plimsol mark is shown at right. Ships can only be loaded to these lines. There are different markings for summer, winter, fresh water, and salt water. Why do the ships have to be loaded to different levels under each of these different conditions? (HINT: Remember what salt and the temperature of the water does to the density of the water.)



3.00 THE NATURE OF MATTER

3.20 The States of Matter

Subtopic/Specification/Content Number	*Test Item*
3.25 Liquids	
A.1/3.25a	1. What is meant by the term *capillarity?* Give at least three examples of capillarity working in your environment. 2. When the nurse sticks your finger and the blood climbs up the wall of a tiny glass tube, this is an example of_____. 3. Sap would not flow in trees if it were not for the principles of (a) inertia. (b) capillarity. (c) changing states of matter. (d) the molecular theory.
A.1/3.25b	Define the term *fluid,* and give at least two properties of fluids.
3.26 Gases	
B.3/3.26a	1. As the volume of a gas changes, what effect does it have on the pressure and temperature of the gas? 2. The gas that comes out of a fire extinguisher that uses carbon dioxide is extremely cold. A. Why is the gas cold? B. When the gas is put into the cylinder, would you expect the cylinder to get hot or cold? Explain your answer.
3.27 Plasma	
A.1/3.27a	Define the term *plasma,* as it applies to the states of matter. List at least five properties of plasma, including its temperature, state of molecules, and energy. List at least five conditions under which plasma is found.

PHYSICAL SCIENCE

3.00 UNIT: THE NATURE OF MATTER

3.30 Topic: Elements

Objectives (*Minimum Objectives)		*Activities*	*References*
3.31 Atomic Theory and Structure			
*B.3/3.31a	The student should demonstrate a knowledge of the atomic theory by either (1) drawing a model of an atom, or (2) writing a short paragraph; and including the position, charge, and nature of protons, electrons, and neutrons.		
*B.1/3.31b	Given two incorrect diagrams of the atom and one correct diagram of the atom, the student should be able to select the diagram that identifies the correct location of neutrons, protons, and electrons.		
*A.1/3.31c	The student should be able to demonstrate a knowledge of the meaning of the terms *atomic weight* and *atomic number* by matching each term with its correct definition.		
3.32 Atomic Structure of Elements			
*B.2/3.32a	The student should be able to show by drawings that the atoms of one element are different than atoms of any other element.		
*B.2/3.32b	The student should be able to define and give two examples of *isotopes*.		
3.33 Periodic Table			
*A.4/3.33a	The student should be able to demonstrate proficiency in the use of the Periodic Table by correctly identifying the atomic number, atomic mass, number of protons, and average number of neutrons and electrons, for at least 10 elements.		

3.00 UNIT: THE NATURE OF MATTER
3.30 Topic: Elements

Objectives	(*Minimum Objectives)	*Activities*	*References*
*D.2/3.33b	The student should demonstrate a knowledge of the structure of the Periodic Chart by being able to state the reasons for the arrangement of elements by groups and by periods.		
3.34 Symbols and Elements			
*B.1/3.34a	Given a list of 20 elements and a copy of the Periodic Table, the student should be able to correctly write the symbol for at least 17 of the 20 elements.		
*B.1/3.34b	Given a list of 20 symbols for elements, the student should by able to name correctly the element for at least 15 of the 20 symbols.		

3.00 THE NATURE OF MATTER

3.30 Elements

Subtopic/Specification/Content Number — *Test Item*

3.31 Atomic Theory and Structure

B.3/3.31a

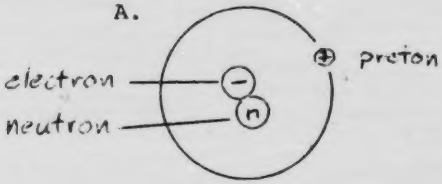
1. Draw a picture of a typical atom, and label the following parts:
   - A. electron
   - B. proton
   - C. neutron
   - D. orbit
   - E. nucleus

2. Write a short paragraph describing the atom. Include in your paragraph (1) the three main particles found in an atom, (2) where they are in the atom, and (3) their charges.

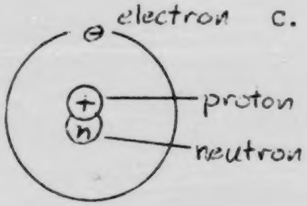
B.1/3.31b

Which diagram of the atom below is correct?

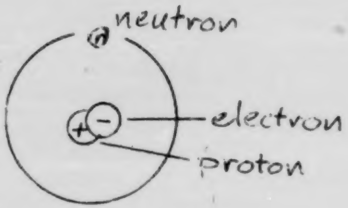
A.



B.



C.



A.1/3.31c

1. The *atomic number* of an element is
   - (a) the number of protons.
   - (b) the number of protons and neutrons.
   - (c) the number of electrons.
   - (d) the position of the nucleus.

2. The *atomic weight (mass)* of an element is the number of
   - (a) protons.
   - (b) protons and neutrons.
   - (c) neutrons and electrons.
   - (d) protons and electrons.

3.00 THE NATURE OF MATTER

3.30 Elements

Subtopic/Specification/Content Number *Test Item*

3.32 Atomic Structure of Elements

B.2/3.32a 1. Make a drawing of two different atoms of two different elements. Show in your drawing how the atoms are different from each other.

B.2/3.32b Define the term *isotope,* and give two examples of isotopes.

3.33 Periodic Table

A.4/3.33a 1. Identify the atomic number, atomic weight, number of protons, and average number of neutrons and electrons for the following elements:

boron
chlorine
carbon
lithium
aluminum
sodium
oxygen
hydrogen
nitrogen
sulfur

2. Fill in the spaces in the following chart:

Name of Element	*Atomic Number*	*Atomic Weight*	*# of protons*	*# of neutrons*	*# of electrons*
sulfur					
hydrogen					
oxygen					
carbon					
helium					
sodium					
chlorine					
uranium					
iron					
copper					

D.2/3.33b What is the reason for the arrangement of the periodic Chart in groups and periods?

3.00 THE NATURE OF MATTER

3.30 Elements

Subtopic/Specification/Content Number — *Test Item*

3.34 Symbols and Elements

B.1/3.34a Using your copy of the Periodic Chart, write the symbol for the elements found below:

aluminum
silicon
beryllium
mercury
mangenese
carbon
helium
potassium
phosphorus
iodine
sodium
nitrogen
iron
oxygen
boron
fluorine
chlorine
zinc
magnesium
lithium

B.1/3.34b Write the name for the element symbols below:

Hg
N
Fe
F
Li
Na
H
Cu
Mn
Ne
O
He
I
Mg
S
C
K
Cl
P
Ag

3.00 UNIT: THE NATURE OF MATTER

3.40 Topic: Compounds

Objectives (*Minimum Objectives)		*Activities*	*References*
3.41 Molecules			
*B.1/3.41a	Given diagrams of atoms and molecules, the student should be able to compare and contrast the structure of atoms and molecules.		
3.42 Properties of Compounds			
*B.3/3.42a	The student should be able to conclude that compounds are composed of two or more elements and have definite composition by weight.		
*A.3/3.42b	Given a list of 20 substances, the student should be able to classify each as being either a compound or an element.		
3.43 Chemical Formulas			
*B.1/3.43a	Given a list of five common compounds, the student should be able to write correctly the chemical formula for at least four of the compounds.		
*B.1/3.43b	Given a list of ten chemical formulae, the student should be able to name the compound and to list the elements in the compound for at least nine of the ten formulae.		

3.00 THE NATURE OF MATTER

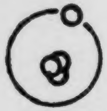
3.40 Compounds

Subtopic/Specification/Content Number — *Test Item*

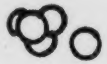
3.41 Molecules

B.1/3.41a

1. Compare and contrast the structures of atoms and molecules shown at the right. How are they similar? How are they different?



Atoms



Molecules

3.42 Properties of Compounds

B.3/3.42a

1. Define the term *compound*.

2. A compound is
   (a) composed of two or more atoms and has an unchanging composition.
   (b) composed of molecules that can shift in number.
   (c) composed of one atom or type of element.
   (d) composed of several atoms that change number.

A.3/3.42b

1. Place a C (for compound) or an E (for element) in front of the following substances:

copper
water
rust
iron sulfide
gold
salt
nylon
paper
aspirin
paint
iron
oxygen
cake
acetic acid
milk
sugar
nitrogen
soap
aluminum
wood

3.43 Chemical Formulas

B.1/3.43a

Write the correct formula for the compounds named below:

lithium chloride
potassium iodide
sulfur dioxide
calcium oxide
carbon disulfide
sodium fluoride
magnesium oxide
sulfuric acid
carbon tetrahydride (methane)
carbon dioxide
hydrogen sulfide
calcium fluroide
zinc chloride
hydrochloric acid
hydrogen oxide
aluminum oxide
carbon tetrachloride
cesium oxide
nitric acid

3.00 THE NATURE OF MATTER

3.40 Compounds

Subtopic/Specification/Content Number	*Test Item*
B.1/3.43b	Name the compound and list the elements in the following substances: HCl $NaCl$ H_2SO_4 $Ca(OH)_2$ MgO H_2O NH_4OH CO_2 Al_2O_3 $Fe_2(SO_4)_3$ Na_2CO_3 $C_6H_{12}O_6$ HNO_3 KCl $FeCl_3$

PHYSICAL SCIENCE

3.00 UNIT: THE NATURE OF MATTER

3.50 Topic: Mixtures

Objectives (*Minimum Objectives)		*Activities*	*References*
3.51 Physical and Chemical Changes			
*A.3/3.51a	When presented with a list of various changes, the student should be able to identify those that are physical and those that are chemical.		
*B.3/3.51b	The student should be able to compare and contrast physical and chemical changes, and list a few examples of each.		
3.52 Elements, Compounds, and Mixtures			
*A.2/3.52a	The student should be able to give several ways to tell if a substance is a mixture.		
*A.3/3.52b	Given a list of several common substances, the student should be able to state if each substance is an element, compound, or mixture.		
3.53 Solutions			
*A.1/3.53a	The student should be able to state at least two properties of liquid solutions.		
*A.1/3.53b	The student should be able to define the terms *solution*, *solute*, *solvent*, *soluability*, and *saturated*.		
A.5/3.53c	The student should be able to list at least three factors that affect the soluability of a solid in a liquid.		

PHYSICAL SCIENCE

3.00 THE NATURE OF MATTER

3.50 Mixtures

Subtopic/Specification/Content Number *Test Item*

3.51 Physical and Chemical Changes

A.3/3.51a Place a P (for physical) or a C (for chemical) next to each of the changes below:

cloth fades
wood is sawed up
a hot metal expands
bread is baked
ripening an apple
digesting food
fire burns
ice melts
camera film is developed
paints are mixed
stretching a rubber band
gunpowder explodes
sugar dissolves
chalk is broken
milk goes sour
paint drys
rusting of iron
an egg is boiled

B.3/3.51b 1. What is meant by the terms *physical* and *chemical change?* Give a few examples of each.

2. A change in size, with no change in composition, is an example of_____.

3. The difference between a *physical* and *chemical change* is that a physical change
(a) changes the substances involved.
(b) can be easily seen, and a chemical change cannot.
(c) involves a change of size or shape.
(d) cannot be turned back into the original object.

3.52 Elements, Compounds, and Mixtures

A.2/3.52a How can you tell if a substance is a mixture?

A.3/3.52b Place a C (for compound), an E (for element), or an M (for mixture) next to the items below:

KoolAid
sugar
salt
silver
iced tea
oxygen
coffee
aluminum
sodium bicarbonate
a solution
air
gold
salt water
copper
paint
sandwich
water
carbon dioxide
corn starch
soup

3.00 THE NATURE OF MATTER
3.50 Mixtures

Subtopic/Specification/Content Number	*Test Item*
3.53 Solutions	
A.1/3.53a	1. Name at least two properties that can be used to identify solutions. 2. Place a check mark (✓) beside those properties below that are characteristic of solutions. _____ Solutions have to be shaken after they have stood for a while. _____ Solutions are clear. _____ Solutions are always composed of a solid and a liquid. _____ Solutions are cloudy. _____ Solutions cannot be filtered. _____ Solutions have particles the size of molecules.
A.1/3.53b	Define the following terms: solution-- solute-- solvent-- soluability-- saturated--
A.5/3.53c	List at least three factors that will affect how well a solid will dissolve in a liquid.

3.00 UNIT: THE NATURE OF MATTER
3.60 Topic: Alloys

Objective	(*Minimum Objective)	*Activities*	*References*
C.6/3.60a	The student should be able to define the term *alloy* and give several examples of alloys and their uses.		

3.00 THE NATURE OF MATTER

3.60 Alloys

Subtopic/Specification/Content Number	*Test Item*
C.6/3.60a	1. What is meant by the term *alloy?* 2. List at least three examples of alloys, and state their use.

4.00 UNIT: THE NATURE OF CHEMICAL ENERGY AND MATTER

4.10 Topic: Atomic Structure and Chemical Properties

Objectives	(*Minimum Objectives)	*Activities*	*References*
4.11 Atomic Structure			
*B.3/4.11a	The student should be able to conclude that atomic structure determines chemical properties of elements.		
*A.5/4.11b	The student should be able to conclude that the number of protons in an atom determines what the element is.		
A.5/4.11c	After reviewing the behavior of atomic particles in many different atoms, the student should be able to conclude that atoms are electrically neutral.		
4.12 Ions and Atomic Structure			
*A.5/4.12a	After studying various theories of electron configuration, the student should be able to state that the chemical behavior of a substance is determined by the electrons.		
*E.2/4.12b	The student should be able to demonstrate an understanding of the formation of ions by drawing at least two examples each of the formation of positive and negative ions.		
*A.2/4.12c	The student should be able to name one condition that is necessary for atoms to form ionic compounds.		
4.13 Electron sharing and transfer			
*A.5/4.13a	After discussing the relation of valence to the position of elements on the chart, the student should be able to state that the number of electrons which can be shared or transferred is called *valence*.		

4.00 UNIT: THE NATURE OF CHEMICAL ENERGY AND MATTER

4.10 Topic: Atomic Structure and Chemical Properties

Objective	(*Minimum Objectives)	*Activities*	*References*
*B.3/4.13b	The student should be able to demonstrate knowledge of the term *valence* by using the term to predict ways in which certain elements will react.		
B.3/4.13c	Given a chemical equation and using the periodic chart of elements, the student should be able to determine the valence associated with each element in a chemical formula.		
4.14 Chemical Changes			
*C.3/4.14a	The student should be able to illustrate the behavior of electrons during a chemical change.		
*A.2/4.14b	The student should be able to name one condition that is necessary for atoms to form molecular compounds.		
C.3/4.14c	The student should be able to demonstrate an understanding of the formation of compounds by making drawings of the following: (a) an example of an ionic compound, and (b) an example of a molecular compound.		
*A.1/4.14d	The student should be able to write correctly at least three examples of electrically balanced formulas for both ionic compounds and molecular compounds.		
4.15 Radicals			
*A.3/4.15a	The student should be able to show a knowledge of chemical radicals by correctly identifying the radicals from a list containting radicals, elements and compounds.		

PHYSICAL SCIENCE

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

4.10 Atomic Structure and Chemical Properties

Subtopic/Specifications/Content Number	*Test Item*
4.11 Atomic Structure	
B.3/4.11a	What determines the chemical properties of elements?
A.5/4.11b	The type of element is determined by the (a) size of the atom. (b) number of protons in the nucleus. (c) number of electrons in the atom. (d) shape of the atom.
	2. The number of which subatomic particles determines whether an element is oxygen, carbon, or something else? (a) neutrons (b) electrons (c) protons (d) nuclei
A.5/4.11c	1. Select five different atoms. Draw them up and show that atoms are electrically neutral.
	2. What is the state that atoms normally like? (a) charged positively. (b) neutral. (c) charged negatively. (d) either negatively or positively charged.
4.12 Ions and Atomic Structure	
A.5/4.12a	1. The chemical behavior of an element is determined by_____.
	2. TRUE OR FALSE The chemical properties of an element are determined by the number of electrons in its outermost shell.

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

4.10 Atomic Structure and Chemical Properties

Subtopic/Specification/Content Number *Test Item*

E.2/4.12b Select the atoms of two different elements. Draw a picture of how those elements form positive ions. Select two other atoms and show how they form negative ions. (Remember, atoms form *one or the other*, never both.)

A.2/4.12c Under what conditions will atoms form ionic compounds? Name at least one.

4.13 Electron Sharing and Transfer

A.5/4.13a 1. What is meant by the term *valence?*

2. The number of electrons that an atom may share or transfer is called_____.

B.3/4.13b 1. TRUE OR FALSE
Carbon and oxygen transfer electrons when they combine.

2. Write the formulas for *calcium oxide* and *magnesium chloride,* and two other compounds of your choice.

B.3/4.13c Tell the valence of each of the elements in the compounds below:

$NaCl$
H_2S
$FeCl_3$
NH_3
HF
H_2O
Al_2O_3
CuO
CH_4
P_2O_5
Na_2O
$FeCl_2$
NO_2
CO_2
MgO

4.14 Chemical Changes

C.3/4.14a 1. Draw a diagram of two elements combining to form a compound, and indicate the sharing or transfer of electrons of the two elements. Repeat, using a second pair of elements.

Continued on next page.

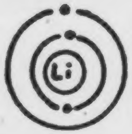
PHYSICAL SCIENCE

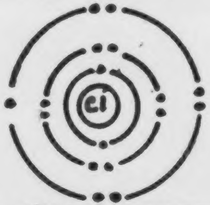
4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

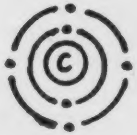
4.10 Atomic Structure and Chemical Properties

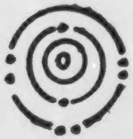
Subtopic/Specification/Content Number *Test Item*

2. Complete the diagrams of the elements below, showing how they would form compounds by transfering or sharing electrons.









A.2/4.14b Name one condition that is necessary for atoms to form molecular compounds.

C.3/4.14c Draw a diagram of an ionic compound, and a molecular compound.

A.1/4.14d In the compounds below, either (1) draw correct diagrams for the formulas, or (2) write in the correct subscript. If the formulas are balanced, do not change them.

B_2O
H_2Br
CaF_2
K_2O
BeO_3
KCl
$NaBr_2$
C_2O
Mg_3N_2
C_2S
Ga_2O_3
Li_3N
LiO
NaI_3
CH_2
NaP_3

4.15 Radicals

A.3/4.15a Place a check mark (✓) beside the radicals in the list below:

Na
He
NH_2
NO_2
NO_3
Ga
Li
Zn
SO_4
Co
Pb
OH
Ca
No
CO_3
Si

PHYSICAL SCIENCE

4.00 UNIT: THE NATURE OF CHEMICAL ENERGY AND MATTER

4.20 Topic: Chemical Reactions

Objectives (*Minimum Objectives)		*Activities*	*References*
4.21 Properties of Chemical Reactions			
*B.1/4.21a	After performing an investigation on chemical reactions, the student should be able to identify and record any signs of chemical changes which occurred in the reaction.		
B.3/4.21b	The student should be able to list at least two variables that could affect a chemical change.		
4.22 Nature of Chemical Reactions			
B.2/4.22a	Given some examples of chemical changes which occur in his environment, the student should be able to determine the reactants, products, and type of chemical reaction.		
*B.3/4.22b	The student should be able to conclude that a chemical change causes a change in composition of matter and an interchange of energy.		
4.23 Types of Chemical Reactions			
A.3/4.23a	After doing laboratory investigations on the four basic types of chemical reactions, the student should be able to describe the four types (*synthesis*, *decomposition*, *simple replacement*, and *double replacement*), and to give at least one example of each.		
A.3/4.23b	The student should be able to classify chemical changes on the basis of the products that are formed.		
B.2/4.23c	Given the reactants and the products of several chemical reactions, the student should be able to identify correctly the types of chemical reactions that have occurred.		

4.00 UNIT: THE NATURE OF CHEMICAL ENERGY AND MATTER

4.20 Topic: Chemical Reactions

Objectives (*Minimum Objectives)		*Activities*	*References*
4.24 Acids, Bases, and Salts			
*A.2/4.24a	The student should be able to list the properties of acids, bases, and salts.		
A.3/4.24b	Given a list of different chemical compounds, the student should be able to classify the compounds as acids, bases, or salts.		
*A.5/4.24c	The student should be able to state the general reaction formula, that an acid and a base combine to produce a salt and water.		

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

4.20 Chemical Reactions

Subtopic/Specification/Content Number	*Test Item*
4.21 Properties of Chemical Reactions	
B.1/4.21a	EVALUATED BY TEACHER-DESIGNED INVESTIGATION. Several common chemical reactions should be done by the student as an investigation.
B.3/4.21b	Name at least two **variables** that can affect a chemical change.
4.22 Nature of Chemical Reactions	
B.2/4.22a	In the chemical reactions listed below, name the *reactants*, *products*, and the *type* of chemical reaction: A. Rusting iron B. Photosynthesis in plants C. Burning wood D. Burning gasoline E. Respiration (breathing) F. Vinegar and baking soda
B.3/4.22b	1. Iron and sulfur are heated to gether in a test tube. A. Why are the remains of the investigation different than either iron or sulfur? B. Why does the mixture of iron and sulfur have to be heated? 2. One indispensable thing that is needed for a chemical reaction to occur is (a) an acid. (b) energy. (c) two explosive chemicals. (d) water.
4.23 Types of Chemical Reactions	
A.3/4.23a	1. Name the four types of chemical reactions, and give at least one example of each.

Continued on next page.

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER
4.20 Chemical Reactions

Subtopic/Specification/Content Number *Test Item*

2. Name the type of chemical reaction that is occurring in each of the equations below:
   - A. $H_2O \rightarrow H_2\uparrow + O_2\uparrow$
   - B. $C + O_2 \rightarrow CO_2\uparrow$
   - C. $BaCl_2 + 2NaOH \rightarrow Ba(OH)_2\downarrow + 2NaCl$
   - D. $CuSO_4 + 2Fe^{++} \rightarrow Fe_2SO_4 + Cu^{++}$

A.3/4.23b

1. What is the type of chemical reaction that has occurred, according to the products given below?
   - A. Oxygen and carbon
   - B. Two chemicals form a third substance
   - C. Two chemicals combine and form two new substances
   - D. When a silver spoon is wrapped in aluminum foil, the silver becomes bright and the aluminum foil crumbles.

2. Wrapping a tarnished silver spoon in aluminum to remove the sulfur is an example of a
   - (a) replacement reaction.
   - (b) double replacement reaction.
   - (c) synthesis reaction.
   - (d) decomposition reaction.

B.2/4.23c

Name the type of chemical reaction that is occurring in each of the equations below:

$C + O_2 \rightarrow CO_2\uparrow$

$NaOH + HCl \rightarrow NaCl + H_2O$

$S + O_2 \rightarrow SO_2\uparrow$

$C_2H_4 + 3O_2 \rightarrow 2CO_2\uparrow + 2H_2O$

$H_2 + Cl_2 \rightarrow 2HCl$

$FeS + 2H^+ \rightarrow Fe^{++} + H_2S$

$2H_2O_2 \rightarrow 2H_2O + O_2\uparrow$

$Cu + 2H_2SO_4 \rightarrow CuSO_4 + 2H_2O + SO_2\uparrow$

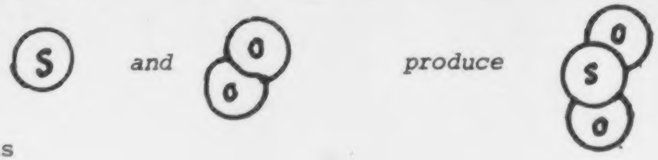
Continued on next page.

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

4.20 Chemical Reactions

Subtopic/Specification/Content Number *Test Item*

2. What type of chemical reaction is illustrated in the diagram below?



4.24 Acids, Bases, and Salts

A.2/4.24a 1. Give at least two properties each of an *acid,* a *base,* and a *salt.*

2. In the descriptions below, indicate whether each refers to an acid, base, or salt:
sour taste
water solutions have a bitter taste
formed when an acid reacts with a base
forms hydroxyl (OH^-) ions in solution
turns red litmus paper blue
neutralizes acids, forming a salt and water
formed when an active metal reacts with an acid
turns blue litmus paper red
contains hydrogen ion (H^+)
caustic--destroys organic material and many metals
neutralizes bases and forms a salt and water
water solutions are slippery to the touch
is usually neutral
has a pH below 7

A.3/4.24b Classify the following compounds as either acids, base, or salts:
$NaOH$
$NaCl$
H_3PO_4
$Ca(OH)_2$
$BeCl_2$
H_2SO_4
$Ba(OH)_2$
$CuSO_4$
Al_2O_3
NH_4Cl
HNO_3
CH_3COOH
$FeCl_3$
NH_4OH
SiO_2
Na_2CO_3
HCl
$LiOH$
CH_3OH
HF

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER
4.20 Chemical Reactions

Subtopic/Specification/Content Number	*Test Item*
A.5/4.24c	1. What is the general reaction formula for an acid-base reaction?
	2. FILL IN THE BLANKS: _____ + Base → _____ + water

4.00 UNIT: THE NATURE OF CHEMICAL ENERGY AND MATTER

4.30 Topic: Chemical Equations

Objectives	(*Minimum Objectives)
A.1/4.30a	After doing laboratory investigations of chemical changes and writing the equations for the changes, the student should be able to state the following: 1. the purpose of symbols and formulas 2. the meaning of the arrow 3. the location of the reactants and products 4. the purpose of subscripts and superscripts
A.4/4.30b	The student should be able to demonstrate comprehension of equation balancing by (1) balancing several simple equations and (2) identifying correctly balanced equations from a list of equations.
A.4/4.30c	The student should be able to demonstrate an understanding of writing and balancing equations by correctly writing and balancing an equation for each of the four types of chemical reactions.

PHYSICAL SCIENCE

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

4.30 Chemical Equations

Subtopic/Specification/Content Number	*Test Item*

A.1/4.30a

1. $2H_2 + O_2 \rightarrow 2H_2O$

   A. What does the arrow stand for?
   B. What are the *reactants?* What are the products?
   C. What is the purpose of the large numbers in front of the formulas?
   D. What is the purpose of the small numbers after the symbols?
   E. Why are symbols and formulas used?

2. Tell how the following words are related:
   equations
   symbols
   formulas
   reactants
   products

3. In the equation below, identify the *reactant, product,* the part that means *produces,* the part that means *two molecules of,* the part that means *two atoms of,* and the *formulas.*

   $2H_2 + O_2 \rightarrow 2H_2O$

A.4/4.30b

1. Balance the following equations. If they are already balanced, leave them as they are.
   $Mg + O_2 \rightarrow MgO$
   $Fe + O_2 \rightarrow Fe_2O_3$
   $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
   $H_2 + O_2 \rightarrow H_2O$
   $C_2H_6 + O_2 \rightarrow CO_2 + H_2O$
   $BaCl_2 + NaOH \rightarrow Ba(OH)_2\downarrow + NaCl$
   $C + O_2 \rightarrow CO_2$
   $Ca + O_2 \rightarrow CaO$
   $Cu + H_2SO_4 \rightarrow CuSO_4 + H_2\uparrow$
   $Al + O_2 \rightarrow Al_2O_3$

4.00 THE NATURE OF CHEMICAL ENERGY AND MATTER

4.30 Chemical Equations

Subtopic/Specification/Content Number	*Test Item*
A.4/4.30c	1. Write and balance an equation for each of the four types of reactions below: A. synthesis-- B. decomposition-- C. simple replacement-- D. double replacement-- 2. Complete and balance the following equations, and tell what type of reaction they represent: A. $Zn + HCl \rightarrow$ B. $Mg + O2 \rightarrow$ C. $BaCl_2 + H_2SO_4 \rightarrow$ D. $H_2O_2 \rightarrow$

4.00 UNIT: THE NATURE OF CHEMICAL ENERGY AND MATTER

4.40 Topic: Chemical Laboratory Use

Objective	*(*Minimum Objectives)*	*Activities*	*References*
*E.2/4.40a	The student should be able to select the correct piece of apparatus for any science investigation, and use the piece of equipment correctly during the investigation.		
*F.2/4.40b	The student should show an appreciation for correct laboratory procedure and safety by safely and correctly handling all laboratory equipment, and by replacing all equipment and cleaning all equipment after use.		

THE ABOVE ARE EVALUATED BY TEACHER OBSERVATION.

PHYSICAL SCIENCE

5.00 UNIT: THE NATURE OF HEAT

5.10 Topic: Heat and Temperature

Objective	*(*Minimum Objectives)*	*Activities*	*References*
5.11 Heat and Molecular Motion			
*B.3/5.11a	After doing a laboratory activity on heat and the motion of molecules, the student should be able to state that the motion of molecules in an object produces heat energy in the object.		
5.12 Heat and Temperature			
*B.3/5.12a	After doing a laboratory activity using a thermometer, the student should be able to state that temperature is a value measurable on a scale, and indicates the ability of a body to transmit or receive heat from another body.		
*B.3/5.12b	After doing a laboratory activity to show the time required to heat two different volumes of the same substance, the student should be able to state that heat is the amount of energy in a substance, while temperature is a measure of that energy, without measuring the amount.		

5.00 THE NATURE OF HEAT

5.10 Heat and Temperature

Subtopic/Specification/Content Number — *Test Item*

5.11 Heat and Molecular Motion

B.3/5.11a

1. When a substance is warmer the molecules
   (a) move faster.
   (b) grow larger.
   (c) move slower.
   (d) stop.

2. When a hammer hits a nail it
   (a) makes the molecules in the nail move faster.
   (b) gives some of its heat to the nail.
   (c) takes some heat from the nail.
   (d) causes the nail to release some of its heat.

3. Heat is a form of
   (a) energy.
   (b) matter.
   (c) both matter and energy.
   (d) temperature.

4. After a car has been driven for a long distance the tires feel hot. Explain.

5.12 Heat and Temperature

B.3/5.12a

1. Temperature is
   (a) the amount of heat in a substance.
   (b) part of the measurement of heat.
   (c) the amount of matter in a substance.
   (d) the calories in a substance.

2. A term for the average speed of molecules is
   (a) expansion.
   (b) calorie.
   (c) heat.
   (d) temperature.

Subtopic/Specification/Content Number *Test Item*

3. The temperature of an object depends on
    - (a) the energy of the object.
    - (b) the weight of the object.
    - (c) the speed of the molecules.
    - (d) the size of the molecules.

B.3/5.12b

1. If a quart of water in Pot *A* has been left on the stove three minutes, and pot *B* has been left on the stove with a quart of water for eight minutes, which contains more energy? Explain.

2. Water at 80°C will not burn you as seriously as oil at 80°C. Explain.

3. You have a bathtub full of warm water and a cup full of hot water.
    - (a) The bathtub has more heat.
    - (b) The cup has more heat.
    - (c) They both have the same amount of heat.
    - (d) They both have the same temperature.

PHYSICAL SCIENCE

5.00 UNIT: THE NATURE OF HEAT

5.20 Topic: Measurement of Heat and Temperature

Objective (*Minimum Objective)		*Activities*	*References*
5.21 Nature of Temperature			
*B.1/5.21a	After doing a laboratory activity on temperature, the student should be able to conclude that the hotness or coldness of an object is determined by the temperature of the object in relation to the temperature of other objects.		
B.3/5.21b	The student should be able to demonstrate an understanding of the difference between heat and temperature by plotting and/or interpreting a graph of temperature and time for heating two different volumes of water to the boiling point.		
B.2/5.21c	The student should be able to devise and do a laboratory investigation which demonstrates that the addition of heat to a substance usually causes an increase in the temperature of that substance.		
5.22 Measurement of Temperature			
*B.1/5.22a	The student should be able to compare and contrast the Celcius and Fahrenheit scales by producing a graph of the two scales, showing their relative freezing and boiling points and several common measurements (such as the average room temperature, blood temperature, etc.)		
B.1/5.22b	The student should be able to demonstrate a knowledge of the Celcius scale by calibrating a thermometer in the Celcius scale.		

PHYSICAL SCIENCE

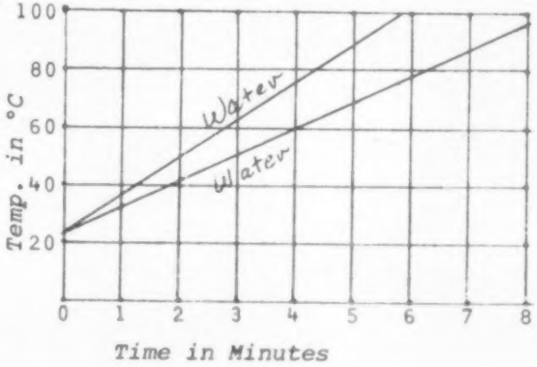
5.00 UNIT: THE NATURE OF HEAT

5.20 Topic: The Measurement of Heat and Temperature

Objective (*Minimum Objectives)		*Activity*	*References*
5.23 Measurement of Heat			
*A.1/5.23a	The student should be able to correctly define the terms *calorie* and *British Thermal Unit.*		
*B.1/5.23b	The student should be able to measure the amount of heat, in calories, in either laboratory investigations or teacher-designed problems.		
5.24 Specific Heat			
*A.5/5.24a	The student should be able to define *specific heat*, and give a brief example of specific heat.		
B.2/5.24b	The student should be able to demonstrate an understanding of specific heat by devising a laboratory investigation which illustrates the differences in specific heat of different substances.		

5.00 THE NATURE OF HEAT

5.20 Measurement of Heat and Temperature

Subtopic/Specification/Content Number	*Test Item*
B.1/5.21a	1. If you place your hand in warm water and the other hand in cold water, and then place both hands in another pan of water; on one hand it may feel cold while on the other hand it will feel warm. How can the pan of water be two temperatures at once? Explain. 2. If you step outside the school and the temperature is 70°F, you may say it is cool outside. But 70°F inside is considered comfortable. Explain.
B.3/5.21b	In the graph to the right, what has caused the difference in the two lines? 
B.2/5.21c	Devise a laboratory investigation that will show what happens to the temperature of a substance as more heat is added to it.

5.22 Measurement of Temperature

B.1/5.22a	Make a graph of Fahrenheit and Centigrade (Celcius) scales side by side. Mark the following positions on each scale, and indicate their temperature in degrees: A. Boiling point of water B. Freezing point of water C. Average room temperature D. Average blood temperature

5.00 THE NATURE OF HEAT

5.20 Measurement of Heat and Temperature

Subtopic/Specification/Content Number	*Test Item*
B.1/5.22b	EVALUATED BY TEACHER OBSERVATION OF STUDENT INVESTIGATION.
5.23 Measurement of Heat	
A.1/5.23a	1. Define the following terms: calorie-- British Thermal Unit (BTU)-- 2. The amount of heat required to raise 1 gram of water 1°C is a_____.
B.1/5.23b	1. What is the amount of heat, in calories, of 1,000 grams of a substance that goes in temperature from 35°C to 55°C? SHOW ALL WORK. 2. How many calories are needed to raise the temperature of 5 grams of a substance 10 degrees C?
5.24 Specific Heat	
A.5/5.24a	Define the term *specific heat*, and give one example of specific heat.
B.2/5.24b	Devise a way that you could determine the specific heat of a substance. 2. A cup of 100 ml of water is heated for three minutes, and the temperature of the water rises 10°C. A cup of 100 ml of oil is heated over the same flame for three minutes, but the temperature of the oil only rises 8°C. Explain.

5.00 UNIT: THE NATURE OF HEAT

5.30 Topic: Effects of Heat on Matter

Objective	(*Minimum Objective)	*Activities*	*References*
*B.1/5.30a	The student should be able to conclude that heating and cooling cause expansion and contraction and that rates vary for different substances in solid and liquid form.		
A.1/5.30b	The student should be able to define correctly *heat of fusion* and *heat of vaporization*.		
A.5/5.30c	The student should be able to describe the principle of *evaporation*.		

PHYSICAL SCIENCE

5.00 THE NATURE OF HEAT

5.30 Effects of Heat on Matter

Subtopic/Specification/Content Number *Test Item*

B.1/5.30a

1. A football was inflated indoors, and when taken out of doors, it became soft. The weather outside was
   (a) cold.
   (b) cool.
   (c) warm.
   (d) hot.

2. Small glass bottles, called *reagent bottles*, frequently have glass stoppers. Sometimes these stoppers become stuck in the bottle. The way to remove them is to leave the bottle in warm or hot water for a few minutes, and the stopper will come out easily. Explain why.

3. When telephone lines are hung from poles in the winter, they do not need as much slack (hanging) between each pole as they do in the summer. Explain.

4. On concrete roads, cars bounce more in the winter because the spaces between each concrete slab are wider than in the summer. Explain why.

5. Explain how a bimetallic thermostat works.

A.1/5.30b

1. Define the following:
   (a) heat of fusion--
   (b) heat of vaporization--

2. It takes more heat to change the temperature of an ice cube from 0°C to 10°C than it does to change the temperature of the same amount of water from 0°C to 10°C. Explain why.

3. Steam heat at 100°C requires more fuel than hot water heat, also at 100°C. This is because
   (a) the steam is hotter than the water.
   (b) it takes extra heat to turn the water to steam.
   (c) more steam is needed than water to heat a room.
   (d) steam heat requires more pipes and a bigger furnace.

4. The amount of heat required to melt one gram of ice is known as the heat of
   (a) ice.
   (b) vaporization.
   (c) water.
   (d) fusion.

5.00 THE NATURE OF HEAT
5.30 Effects of Heat on Matter

Subtopic/Specification/Content Number	Test Item
A.5/5.30c	1. Describe what *evaporation* is, and what effect it has on substances.

2. A washcloth saturated with water will not get as cold as a washcloth saturated with alcohol. A dry washcloth will not change temperature. Explain why.

3. Evaporation
   - (a) warms an object.
   - (b) cools the object.
   - (c) has no effect on objects.
   - (d) makes the object weigh more.

5.00 UNIT: THE NATURE OF HEAT
5.40 Topic: Sources of Heat

Objective	(*Minimum Objective)	Activities	References
*A.2/5.40a	The student should be able to list at least four examples in which heat is formed by the transformation of other forms of energy.		

PHYSICAL SCIENCE

5.00 THE NATURE OF HEAT

5.40 Sources of Heat

Subtopic/Specification/Content Number	*Test Item*
A.2/5.40a	1. List four ways in which energy may be changed from a different form of energy into heat energy. 2. Why does a jar containing water increase its temperature when the jar is given a shaking for a minute?

PHYSICAL SCIENCE

5.00 UNIT: THE NATURE OF HEAT

5.50 Topic: Heat Transfer

Objective	(*Minimum Objective)	*Activities*	*References*
*B.3/5.50a	The student should be able to conclude that heat normally flows from a high-temperature object to a low-temperature object.		
*A.1/5.50b	The student should be able to describe correctly the transfer of heat by conduction, convection and radiation.		
A.2/5.50c	The student should be able to show an understanding of heat transfer by drawing or writing out pictures which illustrate each of the three methods of heat conduction.		
A.2/5.50d	The student should be able to demonstrate an understanding of the principle of *insulation* by citing several examples of insulation in items in his own home.		

PHYSICAL SCIENCE

5.00 THE NATURE OF HEAT

5.50 Topic: Heat Transfer

Subtopic/Specification/Content Number	*Test Item*
B.3/5.50a	1. When heat travels between two objects (a) it moves to the larger object. (b) it moves to the smaller object. (c) it moves to the hotter object. (d) it moves to the colder object. 2. If two objects are at different temperatures, which direction will the heat flow?
A.1/5.50b	1. How is heat transfered by (a) conduction? (b) convection? (c) radiation? 2. When heat is tranferred by *convection*, it is (a) moved on currents of liquid or gas. (b) sent in waves from the object. (c) moved along and through an object. (d) turned into infrared energy. 3. If you place a metal spoon in a bowl of hot soup, the spoon soon becomes hot. This is an example of heat transfer by (a) conduction. (b) convection. (c) radiation. (d) none of the above.
A.2/5.50c	Describe, by drawing or in writing, the three methods of heat transfer.
A.2/5.50d	Give three examples of insulation that you find around your home, and tell what each one is for and how it works.

PHYSICAL SCIENCE

6.00 UNIT: THE NATURE OF ELECTRICITY AND MAGNETISM

6.10 Topic: Magnetism

Objective	(*Minimum Objective)	*Activities*	*References*
*C.3/6.10a	The student should be able to **describe** with simple drawings how a magnet achieves a north and south pole and how it differs from an unmagnetized piece of iron (Domain theory).		
*D.2/6.10b	Given a group of ten objects and a magnet, the student should be able to demonstrate a knowledge of magnetism by predicting and testing the magnetism of each object.		
*B.3/6.10c	Given two bar magnets and some iron filings, the student should be able to demonstrate and sketch (a) the pattern of lines of force for one magnet, (b) the interaction between like poles and (c) the interaction between unlike poles.		
B.2/6.10d	Given a magnetic compass and the magnetic variations, the student should be able to supply the direction of the north magnetic pole and the north geographic pole.		
B.2/6.10e	Given a cork, needle, magnet, and a dish of water, the student should be able to demonstrate how an improvised compass can be made.		
*E.2/6.10f	The student should be able to sketch how the magnetic field would appear about (1) a single magnet, (2) the earth, (3) a north pole of a magnet in the vicinity of a south magnetic pole.		
*B.1/6.10g	Given a world map and a compass, the student should be able to show how a magnetic compass would orient itself anywhere in the world.		

6.00 UNIT: THE NATURE OF ELECTRICITY AND MAGNETISM

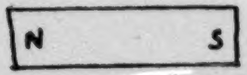
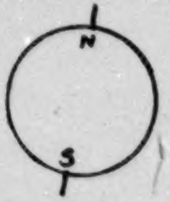
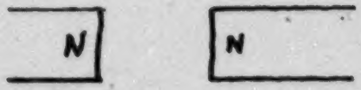
6.10 Topic: Magnetism

Objective	(*Minimum Objective)	Activities	References
*A.5/6.10h	Given the necessary materials, the student should be able to demonstrate knowledge of electromagnets by constructing and demonstrating use of an electromagnet. (The student should then demonstrate how the strength of the magnetic field produced by an electromagnet is affected by the number of turns of wire around the core.)		
A.5/6.10i	The student should be able to demonstrate knowledge of practical uses of electromagnets by explaining the principles of electric motors and generators.		
A.5/6.10j	By discussion and diagrams, the student should be able to explain the principle of the transformer.		

PHYSICAL SCIENCE

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM

6.10 Magnetism

Subtopic/Specification/Content Number	*Test Item*
C.3/6.10a	EVALUATED BY TEACHER OBSERVATION.
D.2/6.10b	EVALUATED BY TEACHER OBSERVATION.
B.3/6.10c	EVALUATED BY TEACHER OBSERVATION.
B.2/6.10d	EVALUATED BY TEACHER OBSERVATION.
B.2/6.10e	EVALUATED BY TEACHER OBSERVATION.
E.2/6.10f	In the diagrams below, draw how the magnetic field would appear around each object: 1. A magnet  2. The earth  3. Two opposing magnets 
B.1/6.10g	EVALUATED BY TEACHER OBSERVATION.
A.5/6.10h	EVALUATED BY TEACHER OBSERVATION.
A.5/6.10i	Explain how (1) an electric motor, and (2) and electric generator works.
	2. Is it possible to have one machine that can be both a motor and a generator? Explain.
A.5/6.10j	Explain, by diagram or in writing, the operation of a transformer.

PHYSICAL SCIENCE

6.00 UNIT: THE NATURE OF ELECTRICITY AND MAGNETISM

6.20 Topic: Electrostatics

Objective	(*Minimum Objective)	*Activities*	*References*
***B.3/6.20a**	The student should be able to conclude that a gain or loss of electrons is responsible for an object having an electrical charge.		
B.2/6.20b	The student should be able to compare and contrast the properties of an electrified object with the properties of a natural magnet, listing at least five ways in which they are alike or different.		
*A.2/6.20c	The student should be able to conclude that friction causes some substances to gain an electric charge (to gain or lose electrons.).		
*D.1/6.20d	Given the basic ideas of electrification, the student should be able to demonstrate successfully how objects can be electrified.		
*B.2/6.20e	The student should be able to explain the buildup of static electrical charges in clouds, and explain why it is unwise to stand near a tree during an electrical storm.		

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM

6.20 Electrostatics

Subtopic/Specification/Content Number *Test Item*

B.3/6.20a

1. Objects become electrified (charged) if
   (a) they gain or lose protons.
   (b) they gain or lose electrons.
   (c) their atoms pick up electricity.
   (d) they attract electricity.

2. If a body loses or transfer electrons, it is said to have a_____.

3. What is a *static charge?*

4. TRUE OR FALSE
   Matter that has an equal number of protons and neutrons has a neutral charge.

5. The only particel that can be rubbed on or off an object is the
   (a) electron.
   (b) nucleus.
   (c) proton.
   (d) neutron.

B.2/6.20b

1. Compare the properties of a magnet and rubbed amber. List at least three ways that they are different, and two ways they are alike.

2. Place a check mark (✓) beside those properties below that are true for *both* amber and lodestone:
   _____If rubbed, it will attract objects.
   _____Repels like objects, attracts unlike objects or ends.
   _____Will pick up materials of many different kinds.
   _____Can be transferred from some objects to other objects by rubbing.

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM

6.20 Electrostatics

Subtopic/Specification/Content Number	*Test Item*
A.2/6.20c	1. Objects are electrified (gain an electric charge) through (a) chemical action. (b) magnetism. (c) friction. (d) transfer of electrical forces.
	2. TRUE OR FALSE Friction and induction are methods that can give objects an electrical charge.
	3. When two objects are rubbed together, what causes both objects to be come charged?
D.1/6.20d	EVALUATED BY TEACHER OBSERVATION OF STUDENT-CONDUCTED DEMONSTRATION.
B.2/6.20e	1. Explain how clouds become charged during a thunderstorm.
	2. Why is it unsafe to stand under a tree during a thunderstorm?
	3. What causes lightning?

6.00 UNIT: THE NATURE OF ELECTRICITY AND MAGNETISM

6.30 Topic: Current Electricity

Objective (*Minimum Objectives)		*Activities*	*References*
6.31 Current Electricity Theory			
*D.2/6.31a	The student should be able to conclude from the classic *Oersted Experiment* that electric currents produce magnetic fields, and the strength of the field $\propto$ strength of the current and the number of turns of wire.		
*A.1/6.31b	The student should be able to define the term *current electricity*.		
B.1/6.31c	The student should be able to demonstrate his knowledge of current electricity by showing the direction of flow or absence of flow, when confronted with appropriate sketches.		
6.32 Electric Circuits			
*C.5/6.32a	The student should be able to construct correctly and demonstrate the use of an electric circuit which includes the four parts of a circuit (source of electricity, path, switch, and resistance or load).		
*A.1/6.32b	The student should be able to define the terms *open circuit* and *closed circuit*.		
*A.5/6.32c	The student should be able to compare and contrast *series* and *parallel circuits*.		
D.1/6.32d	The student should be able to demonstrate a knowledge of circuits in series and circuits in parallel by correctly setting up both types of circuits in a laboratory investigation.		

6.00 UNIT: THE NATURE OF ELECTRICITY AND MAGNETISM
6.30 Topic: Current Electricity

Objective	(*Minimum Objective)	*Activities*	*References*
6.33 Direct and Alternating Current			
*B.2/6.33a	The student should be able to compare and contrast the phenomena of direct current and alternating current.		
6.34 Ohm's Law			
*A.1/6.34a	The student should be able to demonstrate his mastery of terms by matching correctly eight out of ten of the following items from a scrambled list that contains at least four distractors: *volt, voltmeter, resistance, ohm, ampere, ammeter, watt, direct current, alternating current, short circuit, open circuit*, and *closed circuit*.		
*A.5/6.34b	The student should be able to express the relationship of current, voltage, and resistance in a circuit (Ohm's Law).		
*E.1/6.34c	Given the proper equipment, the student should be able to demonstrate an ability to connect correcly a voltmeter and an ammeter in a circuit.		
A.4/6.34d	Given the formula for Ohm's Law, the student should be able to determine correctly the unknown for at least five out of eight problems.		

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM
6.30 Current Electricity

Subtopic/Specification/Content Number	*Test Item*

6.31 Current Electricity Theory

D.2/6.31a

1. According to Oersted, what does an electric current produce?

2. What causes a change in strength of a magnetic field produced by electricity? (2 items)

3. What was Oersted's discovery about electricity and magnetism?

4. The *Oersted Effect* says that a_____is produced about a current-carrying wire.

A.1/6.31b

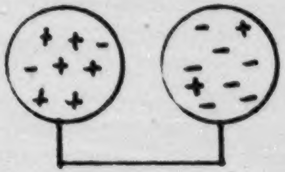
1. What is meant by the term *current electricity?*

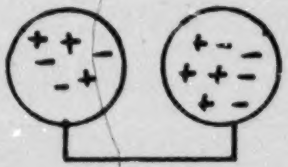
2. Define the following:
current electricity--

B.1/6.31c

1. Which direction does a charge move in an electric circuit?

2. In the sketches below, indicate with arrows which direction the current will flow. Leave blank any sketch that will not have a flow of current.





3. Draw a picture of two charged objects, and show which way current would flow in them.

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM

6.30 Current Electricity

Subtopic/Specification/Content Number	*Test Item*
6.32 Electric Circuits	
C.5/6.32a	EVALUATED BY TEACHER OBSERVATION OF STUDENT-CONSTRUCTED CIRCUITS.
A.1/6.32b	Define the following terms: open circuit-- closed circuit--
A.5/6.32c	1. What are the advantages of *direct current (D.C.)* circuits? What are their disadvantages? 2. What are the advantages of *alternating current (A.C.)* circuits? What are their disadvantages?
D.1/6.32d	EVALUATED BY TEACHER OBSERVATION OF STUDENT-CONSTRUCTED CIRCUITS.
6.33 Direct and Alternating Current	
B.2/6.33a	1. _____is current that moves in only one direction. 2. _____is current that changes direction. 3. Put DC (for direct current) or AC (for alternating current) in each of the spaces below: _____flows in only one direction _____can be changed from one voltage to another by a transformer _____has a large power loss in lines over long distances _____can change direction _____flows easily through a line, once started, with little resistance _____cannot be easily converted to other voltages

PHYSICAL SCIENCE

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM

6.30 Current Electricity

Subtopic/Specification/Content Number *Test Item*

6.34 Ohm's Law

A.1/6.34a Place the correct letter from column B next to the term in column A:

_____volt
_____voltmeter
_____resistance
_____ohm
_____ampere
_____ammeter
_____watt
_____direct current
_____alternating current
_____short circuit
_____open circuit
_____closed circuit

a. unit of electrical power (volts × amps)
b. number of turns of wire in a transformer
c. does not change direction of flow
d. unit of electrical pressure
e. current will not flow due to a break
f. electricity produced from a collapsing magnetic field
g. the unit of resistance
h. instrument used to measure electrical pressure
i. electric current unit
j. instrument used to measure change in direction of current
k. instrument used to measure electrical current
l. current flows through a shortened path
m. current will flow through a complete path
n. direction of flow changes
o. opposition to flowing current
p. variation in a flow of current, on top of a change

A.5/6.34b What is the relationship between *current*, *voltage*, and *resistance*?

E.1/6.34c EVALUATED BY TEACHER OBSERVATION

A.4/6.34d

1. What is the voltage in a circuit with a resistance of 12 Ω and a current of 10 a ?

2. What is the resistance in a circuit with 120 v and 1.5 a ?

3. What is the current in a circuit of 120 v and 7 Ω?

4. What is the maximum voltage that a line rated at 8 a and 25 Ω can carry?

5. What should be the maximum resistance on a line that carries 120 v and 8 a?

6. What should be the maximum amperage on a line that has a resistance of 1,000 Ω and a voltage of 240 v?

6.00 UNIT: THE NATURE OF ELECTRICITY AND MAGNETISM
6.40 Topic: Energy Conversions

Objective	(*Minimum Objective)	*Activities*	*References*
*A.2/6.40a	The student should be able to list and explain at least four examples in which some form of energy may be changed into electricity, and four examples of electrical energy changed into some other form of energy.		

PHYSICAL SCIENCE

6.00 THE NATURE OF ELECTRICITY AND MAGNETISM

6.40 Energy Conversions

Subtopic/Specification/Content Number	*Test Item*
A.2/6.40a	1. List four examples of energy that can be changed into electricity, and explain how it is done.
	2. List four examples of electricity changed into some other form of energy, and explain how it is done.

PHYSICAL SCIENCE

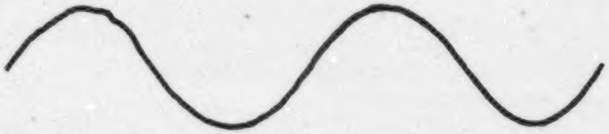
7.00 UNIT: THE NATURE OF SOUND AND WAVES

7.10 Topic: Properties of Waves

Objective	(*Minimum Objective)	*Activities*	*References*
*C.3/7.10a	The student should be able to sketch a transverse wave form and a longitudinal wave form.		
*A.1/7.10b	The student should be able to define the term *wave*.		
*A.3/7.10c	The student should be able to identify various types of waves, and tell how they differ from one another.		
*B.1/7.10d	Given a sketch of a transverse wave form, the student should be able to identify correctly one wave length, crest, trough, and amplitude.		
B.2/7.10e	Given several pictures of transverse wave forms or longitudinal wave forms, the student should be able to correctly identify the wave form which has: 1. the highest and lowest pitch. 2. the greatest and least amplitude. 3. the highest and lowest frequency. 4. a pure tone. 5. a note with a single overtone. 6. a sound with the most noise.		

7.00 THE NATURE OF SOUND AND WAVES

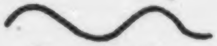
7.10 Properties of Waves

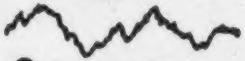
Subtopic/Specification/Content Number	*Test Item*
C.3/7.10a	1. Draw a transverse wave and a longitudinal wave. Label them correctly.
A.1/7.10b	1. What is meant by the term *wave?*
A.3/7.10c	1. What is the difference between a *transverse wave* and a *longitudinal wave?*
	2. Name three different types of waves, and tell how they are different from each other.
B.1/7.10d	In the drawing below, correctly label the wave *length, trough, crest,* and *amplitude.* 
B.2/7.10e	Match the items in column A with the correct drawing in column B.

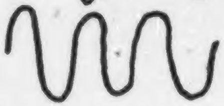
Column A

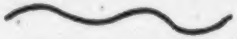
_____the highest pitched wave
_____the lowest pitched wave
_____the greatest amplitude
_____the least amplitude
_____the highest frequency
_____the lowest frequency
_____a pure tone
_____a note with a single overtone
_____a sound with the most noise

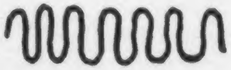
Column B

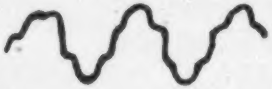
A. 

B. 

C. 

D. 

E. 

F 

7.00 UNIT: THE NATURE OF SOUND

7.20 Topic: Sound Waves

Objective	(*Minimum Objective)	*Activities*	*References*
7.21 Sound as a wave			
*B.2/7.21a	The student should be able to conclude that sound waves are longitudinal waves.		
*B.1/7.21b	Given a sketch of a sound wave, the student should be able to correctly designate compression, rarefaction, and wave length.		
7.22 Producing Sound			
*D.1/7.22a	The student should be able to demonstrate that sound is a form of energy produced by vibrating matter.		
7.23 Transmitting Sound			
*D.2/7.23a	The student should be able to conclude that matter is necessary for sound to travel from one place to another.		
*A.3/7.23b	Given a list of materials that transmit sound, the student should be able to correctly identify those that carry sound the fastest, the slowest, and not at all.		
7.24 Receiving Sound			
*A.2/7.24a	Given a list of the main parts of the ear and an itemized picture of the human hearing mechanism, the student will be able to correctly match the parts of the ear with the correct item.		
*A.2/7.24b	The student should be able to list and explain the three conditions necessary for producing and hearing sounds.		

7.00 UNIT: THE NATURE OF SOUND

7.20 Topic: Sound Waves

Objective	(*Minimum Objective)	*Activities*	*References*
*B.2/7.24c	The student should be able to explain sound as a longitudinal wave, using the molecular and wave theories to explain how sound travels from its source to the person who hears it.		
*A.3/7.24d	When given a description of the surface of a material, the student should be able to correctly identify those that will absorb sound and those that will reflect sound.		
B.2/7.24e	The student should be able to explain the basic principle and use of sonar.		
A.2/7.24f	The student should be able to demonstrate knowledge of acoustical problems by explaining echoes, reverberations, and interference.		
7.25 Sound Properties			
*B.3/7.25a	The student should be able to explain the relationship between the physical characteristics (Length, thickness, tension) of the vibrator and the frequency of the sound.		
*B.3/7.25b	The student should be able to explain the relationship between frequency and pitch.		
*B.2/7.25c	Given a number of diagrams illustrating the number of cycles per second in a wave, the student should be able to arrange them in order from high to low pitch.		
B.1/7.25d	The student should be able to demonstrate his awareness of ultrasonics by listing at least three uses of ultrasonic sounds.		

PHYSICAL SCIENCE

7.00 UNIT: THE NATURE OF SOUND

7.20 Topic: Sound Waves

Objective	(*Minimum Objective)	Activities	References
B.1/7.25e	Given a list of at least five common musical instruments or pictures of them, the student will be able to state how each one produces sound and varies the pitch.		
A.1/7.25f	Given illustrations of wave patterns, the student should be able to distinguish between music and noise.		
B.2/7.25g	The student should be able to demonstrate that the velocity of sound depends upon the medium conducting the vibrati[illegible].		
*C.5/7.25h	The student will demonstrate an understanding of the relative speeds of sounds in solids, liquids, and gases by arranging them in order of increased or decreased ability to conduct sound.		
A.2/7.25i	The student should be able to correctly list approximate speeds of sound in at least four different media (including air as one of the media).		
D.2/7.25j	Based on experimental data, the student should be able to explain the relationship between the speed of sound and the density and elasticity of the states of matter.		
A.5/7.25k	The student should be able to show an understanding of the effect of temperature on sound by explaining the relative speeds of sounds in air of varying temperatures.		
C.2/7.25l	Given the distance to a wall or a cliff, the student should be able to calculate correcly the time required for an echo to return to a person producing a loud sound.		

7.00 UNIT: THE NATURE OF SOUND
7.20 Topic: Sound Waves

Objective	(*Minimum Objectives)	*Activities*	*References*
*A.5/7.25m	The student should be able to explain the relationship between intensity of vibrations (amplitude) and apparent loudness of a sound, listing at least two items of comparison.		
*A.1/7.25n	The student should be able to define the term *decibel*, demonstrating his awareness that the intensity of a sound can be measured.		

7.00 THE NATURE OF SOUND

7.20 Sound Waves

Subtopic/Specification/Content Number — *Test Item*

7.21 Sound as a Wave

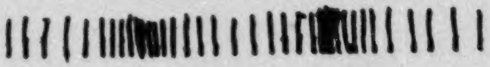
B.2/7.21a

1. What kind of wave is a sound wave?

2. Sound waves are
   (a) transverse.
   (b) torsional.
   (c) longitudinal.
   (d) electromagnetic.

B.1/7.21b

In the drawing below, label *compression, rarefaction,* and *wave length.*



7.22 Producing Sound

D.1/7.22a

EVALUATED BY TEACHER OBSERVATION.

7.23 Transmitting Sound

D.2/7.23a

1. A rock falls on the moon. Would two astronauts be able to hear it? Explain.

2. What kind of matter can transmit sound?

3. What is necessary for sound to travel?

A.3/7.23b

Place an F (for fast), an S (for slow), or an N (for not at all), to indicate the speed of sound in the following materials:

_____steel
_____outerspace
_____air
_____water

_____cork
_____rubber
_____wood
_____helium gas

7.00 THE NATURE OF SOUND

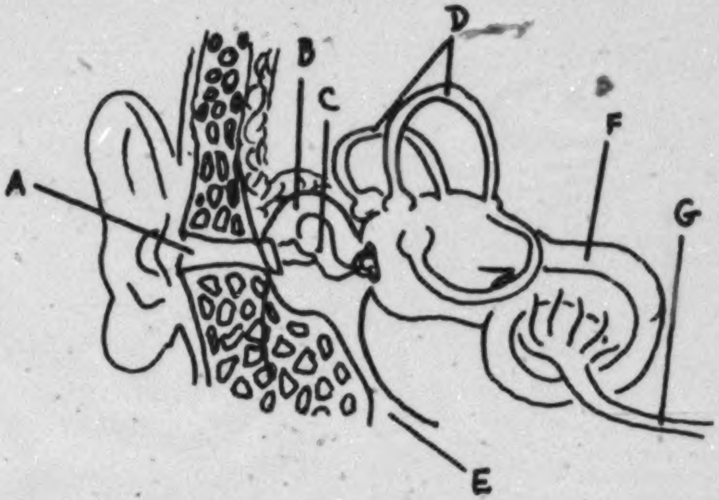
7.20 Sound Waves

Subtopic/Specification/Content Number *Test Item*

7.24 Receiving Sound

A.2/7.24a In the drawing of the human ear at right, match the letters with the names of the parts below:

_____cochlea
_____semicircular canals
_____inner ear
_____outer ear
_____middle ear
_____ear bones (Hammer, anvil, stirrup)
_____eustachian tube
_____auditory nerve



A.2/7.24b 1. In order to hear sound you must:
A._____
B._____
C._____

2. List and explain three conditions necessary for producing and hearing sound.

B.2/7.24c Explain how sound travels, using the molecular and wave theories.

A.3/7.24d Place an A (for absorb) or an R (for reflects) next to the materials below, saying if they will reflect or absorb sound waves:

_____hard, shiny surface
_____many small holes
_____smooth surface
_____soft, elastic surface
_____covered with short hairs or threads
_____liquid

7.00 THE NATURE OF SOUND

7.20 Sound Waves

Subtopic/Specification/Content Number *Test Item*

B.2/7.24e

Explain what *sonar* is, and how it works. What is sonar used for?

A.2/7.24f

1. The problems concerning sound that often arise in buildings are those caused by:
   (a) overtones and responders.
   (b) acoustics and music.
   (c) reverberation and interference.
   (d) longitudinal and transverse waves.

2. How can a large auditorium be soundproofed?

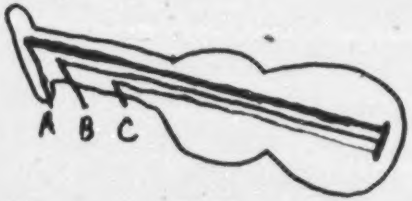
3. Define:
   echo--
   reverberation--
   interference--

4. There are three problems that an acoustical engineer must consider when designing an auditorium. What are they, and how does he deal with them?

7.25 Sound Properties

B.3/7.25a

1. In the diagram at right,
   A. which of the strings on the instrument has the lowest pitch?
   B. which of the strings on the instrument has the highest pitch?



2. Which of the following is true about a vibrator and the properties of the sounds produced?
   A. The longer the vibrator, the higher the pitch.
   B. Sound waves of high frequency produce high pitch.
   C. Sound waves of high frequency are produced by short vibrators.
   D. The thinner the vibrator, the lower the frequency.
   E. Sound waves that are produced when little energy is applied to the vibrator are soft in volume.

7.00 THE NATURE OF SOUND

7.20 Sound Waves

Subtopic/Specification/Content Number — *Test Item*

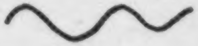
B.3/7.25b

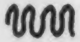
1. What is the relationship between *frequency* and *pitch?*

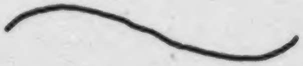
2. Higher-frequency notes have pitches that are
   - (a) high.
   - (b) low.
   - (c) loud.
   - (d) soft.

B.2/7.25c

Arrange the diagrams below in order from the *lowest* pitch to the *highest* pitch.

A.


B.


C.


B.1/7.25d

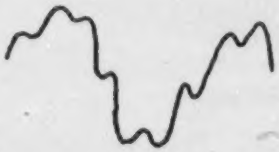
Name at least three uses of ultrasonic sounds.

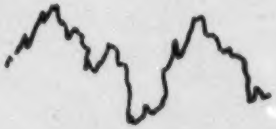
B.1/7.25e

Explain how each of the instruments below produces sound and changes pitch.
- A. piano
- B. violin
- C. trumpet
- D. kettledrum
- E. trombone
- F. clarinet
- G. flute

A.1/7.25f

Which of the patterns below is *music,* and which is *noise?*

A


B.


7.00 THE NATURE OF SOUND

7.20 Sound Waves

Subtopic/Specification/Content Number	*Test Item*
B.2/7.25g	EVALUATED BY TEACHER OBSERVATION OF STUDENT INVESTIGATION.
C.5/7.25h	Place the following in order, from the *best* sound conductor to the *worst*. A. liquid B. gas C. solid
A.2/7.25i	What is the approximate speed of sound in A. steel? B. water? C. air? D. any solid?
D.2/7.25j	Solids conduct sound better and faster than gases. Explain why.
	2. The Skylab astronauts found that they had to shout to each other to make themselves heard. Their air pressure in the cabin was only 5 lb/in^2. Explain the relationship.
A.5/7.25k	1. On cool, bright mornings next to the ocean, sounds can be heard over a great distance. This is because the sound waves are bent from the warm air above into the cool air below, so that the sounds curve back to the ground. Explain why the sound waves bend.
	2. What effect does different air temperature have on sound?
C.2/7.25l	EVALUATED BY TEACHER OBSERVATION OF STUDENT INVESTIGATION.
A.5/7.25m	1. What is the relationship between *amplitude* and *loudness of sound?* Give two examples.
A.1/7.25n	Define the term *decibel*. What is a decibel used for?

7.00 UNIT: THE NATURE OF SOUND
7.30 Topic: Sound Conversion

Objective	(*Minimum Objective)	*Activities*	*References*
*A.2/7.30a	The student should be able to list at least six examples in which sound energy can be transformed into other forms of energy.		

7.00 THE NATURE OF SOUND

7.30 Sound Conversion

Subtopic/Specification/Content Number	*Test Item*
A.2/7.30a	List six examples of sound energy converted into other forms of energy.

8.00 UNIT: THE NATURE OF LIGHT

8.10 Topic: Light Energy

Objective (*Minimum Objective)		*Activities*	*References*
8.11 Properties of Light			
*A.1/8.11a	The student should be able to identify light as a form of radiant energy, with other forms of radiant energy in the electromagnetic spectrum.		
*A.1/8.11b	The student should be able to define the terms *spectrum, transparent,* and *opaque*, and explain how each term applies to radiant energy.		
*B.2/8.11c	Given a chart of the electromagnetic spectrum, the student should be able to compare and contrast visible light with other forms of radiant energy.		
*A.5/8.11d	The student should be able to explain the wave/particle dualism theory of light, citing at least two statements of evidence in support of wave theory and particle theory.		
*A.2/8.11e	The student should be able to state that light is produced by the movement of electrons from higher to lower energy levels.		
*D.2/8.11f	The student should be able to state that light waves can travel through a vacuum and sound waves cannot.		
*B.1/8.11g	The student should be able to state what happens to light as it passes through transparent colored objects, when presented with examples.		
*A.2/8.11h	The student should be able to trace a ray of light from the source to the brain, through the eye, naming all the important parts.		

8.00 UNIT: THE NATURE OF LIGHT
8.10 Topic: Light Energy

Objective	(*Minimum Objective)	Activities	References
*B.3/8.11i	The student should be able to explain why objects appear to have different colors.		
8.12 Energy Conversions			
*A.2/8.12a	The student should be able to describe at least four examples in which light energy can be produced from other forms of energy.		
*B.3/8.12b	The student should be able to demonstrate at least one example in which light energy is produced from another form of energy.		
*A.2/8.12c	The student should be able to list and describe at least five examples in which light energy is changed into other forms of energy.		
*B.2/8.12d	The student should be able to demonstrate at least one example in which light energy is changed into another form of energy.		

8.00 THE NATURE OF LIGHT

8.10 Light Energy

Subtopic/Specification/Content Number *Test Item*

8.11 Properties of Light

A.1/8.11a

1. List, in order of wavelength, the forms of energy in the electromagnetic spectrum.

2. Identify the forms of radiant energy below by placing the name of the energy in the space provided.

_____only form of radiant energy visible to the human eye.
_____rays responsible for tanning the skin
_____band of radiant energy used in broadcasting
_____heat waves
_____rays used in treatment of cancer
_____rays that pass through the body and are used in medicine and industry
_____waves from outer space
_____form of radiant energy necessary for green plants
_____radiant energy responsible for making of vitamin D
_____rays used in the treatment of strained muscles
_____form of radiant energy that contains all color

3. Light is a form of _____ energy.

4. The term below that includes all the others is
   (a) light waves.
   (b) electromagnetic waves.
   (c) infrared waves.
   (d) radio waves.

5. List five forms of energy found in the electromagnetic spectrum.

A.1/8.11b

Define the terms below, and explain how each one applies to radiant energy:
spectrum--
radiant--
opaque--
transparent--

8.00 THE NATURE OF LIGHT

8.10 Light Energy

Subtopic/Specification/Content Number *Test Item*

B.2/8.11c

1. How is visible light similar to the other forms of radiation in the electromagnetic spectrum?

2. How is visible light different than the other forms of radiation in the electromagnetic spectrum?

A.5/8.11d

1. What evidence can you give to support the theory that light is a particle? What evidence do you have that it is a wave?

2. Place a W (for wave), a P (for particle), or a B (for both) next to the statement below that supports each theory of light:
_____Travels in a straight line.
_____Can travel through a vacuum.
_____Refracts when slowed down in a medium.
_____Angle of reflection equals angle of incidence on a smooth surface.
_____Causes interference patterns when out of phase.
_____Has a small amount of mass.
_____Two beams of light can cross each other without hitting.

A.2/8.11e

1. How does an atom produce light?

2. Light is produced when
(a) atoms get red-hot.
(b) molecules strike each other and release energy.
(c) electrons fall from a higher to a lower energy level.
(d) the nucleus of an atom vibrates and splits apart.

D.2/8.11f

1. What is one big difference between light waves and sound waves?

2. Compare the effect of the density of a medium on light and sound.

8.00 THE NATURE OF LIGHT

8.10 Light Energy

Subtopic/Specification/Content Number	*Test Item*
B.1/8.11g	1. If you look at a white bowl of red cherries through a blue piece of cellophane, what will you see? Explain.
	2. If you look at a green-and-white striped shirt through a piece of green cellophane, what will you see? Explain.
	3. If you look at a white-colored object through a piece of red cellophane, what will happen? Explain.
A.2/8.11h	1. Trace a ray of light from in front of the eye, through the eye to the brain, and name the important parts that the ray passes through, and describe the function of each part.
	2. Tell what the function is of each part of the eye below, and tell where it is found. retina-- lens-- iris-- pupil-- cornea-- optic nerve--
B.3/8.11i	1. Under red light, what color will a white shirt appear to be? Explain.
	2. Each of the colored pieces of paper below are held under blue light. Tell what color you would see, and why. a. red b. blue c. white

8.00 THE NATURE OF LIGHT

8.10 Light Energy

Subtopic/Specification/Content Number	*Test Item*
8.12 Energy Conversions	
A.2/8.12a	Name at least four examples in which light energy is produced from other forms of energy.
B.3/8.12b	EVALUATED BY TEACHER OBSERVATION OF STUDENT DEMONSTRATION.
A.2/8.12c	Name and describe five examples of light energy changed into other forms of energy.
B.2/8.12d	EVALUATED BY TEACHER OBSERVATION OF STUDENT DEMONSTRATION.

8.00 UNIT: THE NATURE OF LIGHT

8.20 Topic: Measurement of Light

Objectives (*Minimum Objectives)		*Activities*	*References*
*A.1/8.20a	The student should be able to define the term *intensity* and state the unit of measure for intensity.		
*A.1/8.20b	The student should be able to define the term *illumination*.		
B.2/8.20c	After using a photometer in at least four different areas, the student should be able to list the two units of measure for illumination.		
A.5/8.20d	The student should be able to demonstrate knowledge of the relationship that exists among speed of light, frequency, and wave length by correctly writing the equation and by properly computing any one of the terms when the other two are given.		
*A.2/8.20e	The student should be able to state the speed of light in air in both the metric system and the English system.		

8.00 THE NATURE OF LIGHT

8.20 Measurement of Light

Subtopic/Specification/Content Number	*Test Item*
A.1/8.20a	1. What is meant by *intensity?* How is intensity measured?
	2. *Candlepower* is a measure of the_____of an object.
	3. What properties of light can be measured and what are the units of measurement for each?
A.1/8.20b	1. Define the term *illumination*.
	2. The planets and the moon can be seen because they are _____ by the sun.
B.2/8.20c	What are the two units of measure for illumination?
A.5/8.20d	1. What is the relationship between frequency, wave length, and the speed of light?
	2. What is the equation for the frequency, wave length, and the speed of light?
A.2/8.20e	State the speed of light in air, in both English and metric units.

8.00 UNIT: THE NATURE OF LIGHT

8.30 Topic: Reflection and Mirrors

Objectives (*Minimum Objectives)		*Activities*	*References*
8.31 Reflection			
*A.5/8.31a	The student should be able to state the law of reflection using the terms *angle of incidence* and *angle of reflection*.		
*B.2/8.31b	The student should be able to demonstrate an understanding of the law of reflection by predicting the angle at which light will be reflected from a surface when given the angle at which it strikes the surface.		
8.32 Mirrors			
C.5/8.32a	The student should be able to demonstrate his understanding of the behavior of mirrors by sketching a simple light ray diagram showing an object, the mirror, and the image associated with (a) a plane mirror, (b) a concave mirror, and (c) a convex mirror.		
*A.2/8.32b	The student should be able to list two uses for concave mirrors and two uses for convex mirrors.		

8.00 THE NATURE OF LIGHT
8.30 Reflection and Mirrors

Subtopic/Specification/Content Number — *Test Item*

8.31 Reflection

A.5/8.31a

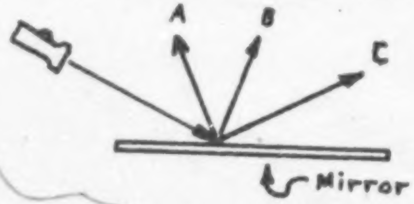
1. What is the *Law of Reflection?*

2. What is the relationship between the *angle of incidence* and the *angle of reflection?*

3. The *Law of Reflection* states that
   (a) light will reflect when it hits a mirror.
   (b) the angle of incidence is equal to the angle of reflection.
   (c) light striking a mirror will bend until it meets a focal point.
   (d) light will travel in a straight line.

B.2/8.31b

1. Who will see the flashlight in the mirror below: person A, B, or C? Explain.

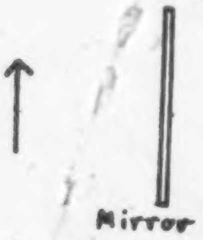


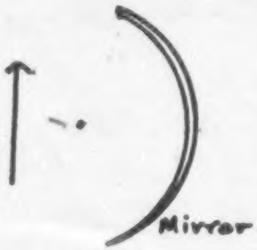
2. If light strikes a mirror at a 90° angle, will you be able to see it if you stand directly in front of the mirror? Explain.

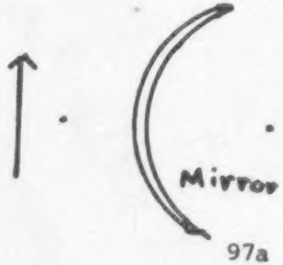
8.32 Mirrors

C.5/8.32a

In the image mirrors below, draw the path that the light rays would follow, show where an image would show and what it would look like.







8.00 THE NATURE OF LIGHT
8.30 Reflection and Mirrors

Subtopic/Specification/Content Number	*Test Item*
A.2/8.32b	List two uses for concave mirrors and two uses of convex mirrors.

PHYSICAL SCIENCE

8.00 UNIT: THE NATURE OF LIGHT
8.40 Topic: Refraction and Lenses

Objectives (*Minimum Objectives)		*Activities*	*References*
8.41 Refraction			
*C.4/8.41a	The student should be able to sketch how a light ray will be refracted when it eneters a more (or less) dense medium.		
*B.3/8.41b	The student should be able to explain how light is separated into various colors by a prism.		
*A.5/8.41c	Using the terms *transmit*, *filter*, and *absorb*, the student should be able to explain what happens when light passes through colored objects.		
*B.3/8.41d	The student should be able to describe the behavior of a ray of light when it strikes objects that are opaque, translucent, and transparent.		
B.2/8.41e	The student should be able to construct diagrams to explain the causes of mirages.		
8.42 Lenses			
*B.1/8.42a	The student should be able to conclude that lenses refract light.		
*B.2/8.42b	The student should be able to compare and contrast what occurs when parallel rays of light pass through convex and concave lenses.		
A.5/8.42c	The student should be able to explain the principle of compound lenses.		

PHYSICAL SCIENCE

8.00 UNIT: THE NATURE OF LIGHT
8.40 Topic: Refraction and Lenses

Objectives (*Minimum Objectives)		*Activities*	*References*
*A.1/8.42d	The student should be able to compare and contrast real and virtual images.		
B.2/8.42e	The student should be able to construct ray path diagrams of images formed by concave and convex lenses.		
*A.2/8.42f	The student should be able to report on the comparison of the structure and operation of the human eye and camera.		
A.2/8.42g	The student should be able to identify and explain the type of corrective lenses needed for near-sightedness and far-sightedness.		

PHYSICAL SCIENCE

8.00 THE NATURE OF LIGHT

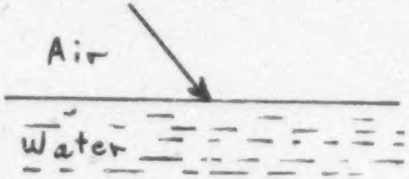
8.40 Refraction and Lenses

Subtopic/Specification/Content Number *Test Item*

8.41 Refraction

C.4/8.41a

1. Draw a diagram which shows what happens to a light ray as it passes from air to water.
2. In the diagram below, show what will happen to the light ray.



B.3/8.41b

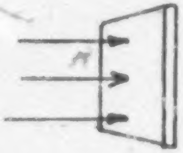
How does a prism separate light into various colors?

A.5/8.41c

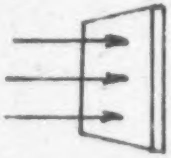
1. A green piece of transparent glass
   (a) absorbs all colors.
   (b) absorbs green and transmits other colors.
   (c) transmits green and absorbs other colors.
   (d) reflects all colors.
2. What happens to light as it passes through a transparent colored object?

B.3/8.41d

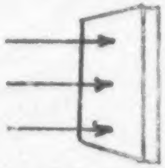
1. Draw the path of the light rays in each of the objects below:



opaque



transparent



translucent

8.00 THE NATURE OF LIGHT

8.40 Refraction and Lenses

Subtopic/Specification/Content Number — *Test Item*

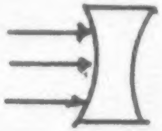
B.2/8.41e — Explain, using diagrams, what causes a *mirage*.

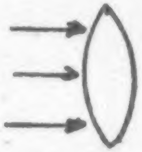
8.42 Lenses

*B.1/8.42a — 1. Specially ground pieces of glass that refract light rays that pass through them are
- (a) mirrors.
- (b) lenses.
- (c) reflectors.
- (d) absorbers.

2. How does a lens produce its effects?

*B.2/8.42b — Complete the lens diagrams below, for the light rays:

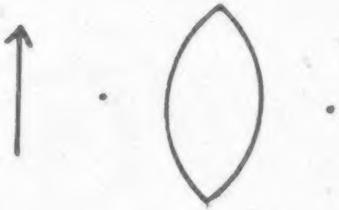


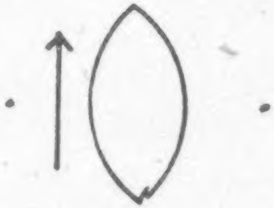


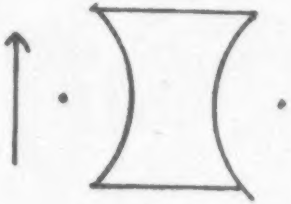
A.5/8.42c — Explain how the compound lenses in a microscope or telescope work.

*A.1/8.42d — What is the difference between a real image and a virtual image?

B.2/8.42e — Complete the ray paths, and draw images, for the diagrams below:







PHYSICAL SCIENCE

8.00 THE NATURE OF LIGHT

8.40 Refraction and Lenses

Subtopic/Specifcation/Content Number	*Test Item*
*A.2/8.42f	1. Briefly tell the difference in the way a camera focuses an image and the way your eye focuses an image.
	2. How is a camera similar to the human eye? Compare the structures of each.
A.2/8.42g	1. A nearsighted person's vision would be corrected by using _____ lenses.
	2. How do lenses correct nearsightedness or farsightedness?

9.00 UNIT: THE NATURE OF NUCLEAR ENERGY

9.10 Topic: Atomic Structure

Objectives (*Minimum Objectives)		*Activities*	*References*
*A.2/9.10a	The student should be able to complete correctly a chart showing the number of protons, neutrons, and electrons in the first 20 elements of the Periodic Chart.		
*A.1/9.10b	The student should be able to differentiate between the terms *atomic mass* and *atomic number*.		
*A.1/9.10c	The student should be able to define and give five examples of isotopes.		

PHYSICAL SCIENCE

9.00 THE NATURE OF NUCLEAR ENERGY

9.10 Atomic Structure

Subtopic/Specification/Content Number — *Test Item*

A.2/9.10a Fill out the chart below by completing the blanks:

Name	*# of prtons*	*# of neutrons*	*# of electrons*	*Atomic Mass*	*Atomic Number*
Sodium					
Chlorine					
Calcium					
Potassium					
Helium					
Carbon					
Oxygen					
Nitrogen					
Fluorine					
Hydrogen					

A.1/9.10b In U^{238} the number stands for:

- (a) atomic mass.
- (b) atomic number.
- (c) number of neutrons.
- (d) number of electrons.

2. The *atomic number* is the number of
   - (a) protons.
   - (b) electrons.
   - (c) protons and neutrons.
   - (d) neutrons.

3. The *atomic mass* is the number of
   - (a) protons.
   - (b) electrons.
   - (c) neutrons and protons.
   - (d) neutrons.

A.1/9.10c Define the term *isotope*, and give five examples of common isotopes.

9.00 UNIT: THE NATURE OF NUCLEAR ENERGY
9.20 Topic: Radioactivity

Objectiv(*Minimum Objectives)		*Activities*	*References*
9.21 Man and Radioactivity			
F.6 /9.21a	The student should be able to list and briefly describe the work of at least four scientists who contributed to our knowledge of nuclear energy.		
*A.2/9.21b	The student should be able to list at least two ways in which exposure to radiation may be dangerous to man.		
*A.2/9.21c	The student should be able to demonstrate knowledge of natural and artificial radioactivity by listing at least five examples of each.		
9.22 Properties of Radiation			
*A.1/9.22a	The student should be able to demonstrate knowledge of radioactivity by listing three types of radiation (alpha [α], beta [β], and gamma[γ]) and explaining the difference between the three types.		
*B.3/9.22b	After class discussion of an example of the disintegration of a radioactive element, the student should be able to conclude that the emission of radiation may affect the nature and structure of the atom.		
*A.1/9.22c	The student should be able to state the definition of the term *half-life*.		

9.00 THE NATURE OF NUCLEAR ENERGY

9.20 Radioactivity

Subtopic/Specification/Content Number *Test Item*

9.21 Man and Radioactivity

F.6/9.21a

1. Radioactivity was discovered by
   (a) Einstein.
   (b) Rutherford.
   (c) Curie.
   (d) Becquerel.

2. Rutherford
   (a) described three types of radiation.
   (b) discovered radioactivity.
   (c) discovered radium.
   (d) showed that matter can be changed into energy.

3. Polonium and radium were discovered by
   (a) Einstein.
   (b) Rutherford.
   (c) Curie.
   (d) Becquerel.

4. $E = mc^2$ **is associated with which of the following scientists?**
   (a) Einstein
   (b) Rutherford
   (c) Curie
   (d) Becquerel

5. Name four scientists whose work has been associated with atomic energy, and briefly describe their contributions.

6. The two scientists who first split the U^{235} atom were
   (a) Bohr and Dalton.
   (b) Compton and Einstein.
   (c) Fermi and Rutherford.
   (d) Hahn and Strassman.

9.00 THE NATURE OF NUCLEAR ENERGY

9.20 Radioactivity

Subtopic/Specification/Content Number	*Test Item*
A.2/9.21b	1. Why is it important to be able to detect radioactivity?
	2. List two dangerous effects radioactivity has on the human body.
A.2/9.21c	1. List five examples of natural radioactivity, and five examples of artificial radioactivity.

9.22 Properties of Radiation

Subtopic/Specification/Content Number	*Test Item*
A.1/9.22a	1. Name the three types of radiation, and tell how they are different from each other.
	2. *Alpha* (α) particles are (a) electrons. (b) protons and electrons. (c) protons and neutrons. (d) electromagnetic waves.
	3. *Beta* (β) particles are (a) electrons. (b) protons. (c) protons and electrons. (d) electromagnetic waves.
	4. *Gamma* (γ) particles are (a) electrons. (b) protons. (c) protons and electrons. (d) electromagnetic waves.

PHYSICAL SCIENCE

9.00 THE NATURE OF NUCLEAR ENERGY
9.20 Radioactivity

Subtopic/Specification/Content Number	*Test Items*
B.3/9.22b	1. The following is a radioactive decay. Which of the choices below is the correct loss? $_{88}\mathrm{Ra}^{226} \rightarrow {}_{86}\mathrm{Rn}^{222}$ (a) β-particle (Beta particle) (b) α-particle (Alpha particle) (c) γ ray (Gamma ray) (d) neutron 2. When an atom releases radiation, how is the atom affected?
A.1/9.22c	What is meant by the term *half-life?*

PHYSICAL SCIENCE

9.00 UNIT: THE NATURE OF NUCLEAR ENERGY

9.30 Topic: Nuclear Fission

Objectives (*Minimum Objectives)		*Activities*	*References*
9.31 Uncontrolled Chain Reactions			
*D.2/9.31a	The student should be able to demonstrate an understanding of the phenomenon of chain reaction by devising and performing a demonstration of a chain reaction.		
C.4/9.31b	The student should be able to demonstrate an understanding of an uncontrolled chain reaction by diagramming the nuclear fission which occurs in an atomic explosion.		
9.32 Nuclear Reactors			
B.3/9.32a	The student should be able to diagram and explain the reaction that occurs inside a nuclear reactor (including the outer shields, fissionable materials, moderators, control rods, and systems for transferring energy).		
A.2/9.32b	The student should be able to list four uses of nuclear reactors.		

9.00 THE NATURE OF NUCLEAR ENERGY

9.30 Nuclear Fission

Subtopic/Specification/Content Number	*Test Item*
9.31 Uncontrolled Chain Reactions	
D.2/9.31a	EVALUATED BY TEACHER OBSERVATIONS OF STUDENT CONDUCTED DEMONSTRATION.
C.4/9.31b	Draw a diagram that shows what occurs in an uncontrolled chain reaction (nuclear explosion).
9.32 Nuclear Reactors	
B.3/9.32a	Draw a diagram of a nuclear reactor, and explain its function and the function of the following parts: *outer shields, fissionable materials, moderators, control rods, energy transfer systems.*
A.2/9.32b	List four uses of nuclear reactors.

9.00 UNIT: THE NATURE OF NUCLEAR ENERGY
    9.40 Topic: Nuclear Fusion

Objectives (*Minimum Objectives)		*Activities*	*References*
*B.2/9.40a	The student should be able to compare and contrast fission and fusion, listing at least four items for each.		
D.3/9.40b	The student should be able to briefly explain why research into nuclear fusion is considered to be important in aleviating the energy crisis.		

9.00 THE NATURE OF NUCLEAR ENERGY

9.40 Nuclear Fusion

Subtopic/Specification/Content Number	*Test Item*
B.2/9.40a	Compare and contrast nuclear *fission* and *fusion*, listing at least four similarities or differences for each.
D.3/9.40b	Why is nuclear fusion considered to be one of the best hopes for energy in the future?

9.00 UNIT: THE NATURE OF NUCLEAR ENERGY

9.50 Energy Conversions

Objectives (*Minimum Objectives)		*Activities*	*References*
*A.1/9.50a	Given Einstein's Formula, $E = mc^2$, the student should be able to explain the meaning of each letter in the formula, and what the entire formula stands for.		
*D.3/9.50b	The student should be able to conclude that conversion of a small amount of mass produces a tremendous quantity of energy.		
*A.2/9.50c	The student should be able to list at least three energy forms which result from nuclear reactions.		

PHYSICAL SCIENCE

9.00 THE NATURE OF NUCLEAR ENERGY

9.50 Energy Conversions

Subtopic/Specification/Content Number	*Test Item*
A.1/9.50a	1. The formula $E = mc^2$ means_____. **2. What does each of** the letters in the formula $E = mc^2$ stand for? What is the meaning of the entire formula?
D.3/9.50b	1. What is the amount of energy that is produced by a small amount of matter? 2. If matter is converted into energy, (a) a large amount of energy is produced. (b) a small amount of energy is produced. (c) no energy is produced. (d) some energy is lost.
A.2/9.50c	Name three energy forms which result from nuclear reactions.

9.00 UNIT: THE NATURE OF NUCLEAR ENERGY

9.60 Topic: Radioisotopes

Objectives (*Minimum Objectives)	*Activities*	*References*
A.4/9.60a Based on library research, the student should be able to list at least six ways in which radioistopes are presently being used in medicine, industry, agriculture, etc.		
F.5/9.60b The student should be able to determine the value of radioactivity to man by comparing the hazards it presents with the benefits that can be derived from this energy source.		

9.00 THE NATURE OF RADIOACTIVITY

9.60 Radioisotopes

Objectives (*Minimum Objectives)		Activities	References
A.4/9.60a	List six ways in which radioisotopes are presently used by man.		
F.5/9.60b	Form your own opinion on the value of radioactivity and radioisotopes. Are they harmful or beneficial? Back up your conclusions with examples and explanations.		

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.10 Topic: Forces

Objectives	(*Minimum Objectives)	*Activities*	*References*
*B.3/10.10a	The student should be able to demonstrate that an unbalanced force can change the size, shape, or motion of an object.		
*B.2/10.10b	The student should be able to demonstrate the difference between a balanced and an unbalanced force.		

PHYSICAL SCIENCE

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.10 Forces

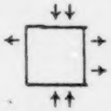
Subtopic/Specification/Content Number *Test Item*

B.3/10.10a

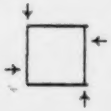
1. What can forces do? (List three things.)

2. Which direction, and how fast, will the following boxes move?

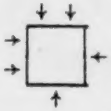
(a)



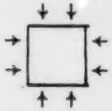
(b)



(c)

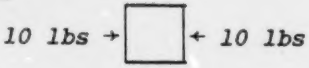


(d)

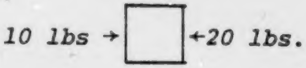


3. In which direction will the following boxes move?

(a)



(b)



4. Two forces, ten pounds and five pounds, push in opposite directions. Are they balanced or unbalanced? Is there a resultant force?

5. A force that can cause an object to move, change direction or speed, is a
   - (a) balanced force.
   - (b) unbalanced force.
   - (c) tendency.
   - (d) inertial force.

B.2/10.10b

EVALUATED BY TEACHER OBSERVATION OF STUDENT DEMONSTRATION.

PHYSICAL SCIENCE

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.20 Topic: Measurement of Forces

Objectives	(*Minimum Objectives)	*Activities*	*References*
C.3/10.20a	The student should be able to demonstrate an ability to measure forces, in terms of a *dyne*, *Newton*, or *pound*, by determining the force used to do a given work and using the appropriate term.		

PHYSICAL SCIENCE

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.20 Measurement of Forces

Subtopic/Specification/Content Number	*Test Item*
C.3/10.20a	1. A unit used in the measurement of force is the (a) pound. (b) foot-pound. (c) foot-pound/second. (d) horsepower.
	2. If you had an object that weighs one Kilogram and moves one meter/second^2, what units would you use to measure its force? (a) pounds. (b) dynes. (c) Newtons. (d) foot-pounds.

PHYSICAL SCIENCE

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.30 Topic: Gravitation

Objectives	(*Minimum Objectives)	*Activities*	*References*
*B.2/10.30a	The student should be able to compare and contrast *mass* and *weight*.		
*C.1/10.30b	The student should be able to recognize the distinction between *mass* and *weight* by giving at least two examples of their differences.		

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10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.30 Gravitation

Subtopic/Specification/Content Number	*Test Item*
B.2/10.30a	1. What is the difference between *mass* and *weight?*
	2. How are *mass* and *weight* similar?
	3. Which of the following does *not* change? (a) mass (b) weight (c) force
	4. Mass is measured with a (a) spring scale. (b) balance. (c) graduated cylinder. (d) metric ruler.
C.1/10.30b	1. Give at least two examples of the way mass and weight are different.
	2. When the astronauts measured themselves in Skylab, one of the thing sthey would check is (a) their mass. (b) their weight. (c) the difference in their weight on earth and in space.

PHYSICAL SCIENCE

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.40 Topic: Newton's Laws of Motion

Objectives	(*Minimum Objectives)	*Activities*	*References*
10.41 Inertia			
*A.5/10.41a	The student should be able to state Newton's First Law of motion.		
*B.3/10.41b	The student should be able to state the relationship between mass and inertia.		
B.1/10.41c	The student should be able to sketch an example of a centripetal force and a centrifugal force.		
*A.2/10.41d	The student should be able to list at least four ways to reduce friction.		
10.42 Speed and Acceleration			
*C.1/10.42a	The student should be able to demonstrate his understanding of the term *speed* by working several problems involving the three parts of speed.		
*A.5/10.42b	The student should be able to state Newton's Second Law of Motion.		
*A.2/10.42c	The student should be able to list two characteristics of free-falling bodies.		
*C.1/10.42d	The student should be able to demonstrate his understanding of the term acceleration by working several problems involving the four parts of acceleration.		
C.6/10.42e	The student should be able to correctly interpret speed/time and distance/time graphs, and be able to distinguish the advantages and disadvantages of taking an average for determining acceleration.		

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.40 Topic: Newton's Laws of Motion

Objectives	(*Minimum Objectives)	*Activities*	*References*
10.43 Action and Reaction			
*A.5/10.43a	The student should be able to state Newton's Third Law of Motion.		
*A.1/10.43b	The student should be able to define and give an example of momentum.		
*C.1/10.43c	The student should be able to show an understanding of the characteristics of momentum by stating the direction of resultant motion when presented with examples of objects with different amounts of momentum.		

PHYSICAL SCIENCE

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.40 Newton's Laws of Motion

Subtopic/Specification/Content Number *Test Item*

10.41 Inertia

A.5/10.41a What is Newton's First Law of Motion?

B.3/10.41b What is the relationship between mass and inertia?

B.1/10.41c Draw an example of a centripetal force and a centrifugal force.

A.2/10.41d Name at least four ways to reduce friction.

10.42 Speed and Acceleration

C.1/10.42a 1. Write down three different speeds using any units except miles/hour.

2. Two trains pass each other going opposite directions. Train A travels 300 Km in 5 hours. Train B travels 450 Km in 7.5 hours. Assuming the trains maintain a constant speed, compare their speeds.

A.5/10.42b What is Newton's Second Law of Motion?

A.2/10.42c List two characteristics of free-falling bodies.

C.1/10.42d 1. A car accelerates from 0 to 75 Km in 10 seconds. What is the car's average acceleration? SHOW ALL WORK.

2. A car accelerates as follows:

Time(sec)	Speed(Km/sec)
0	0
1	5
2	10
3	15
4	20

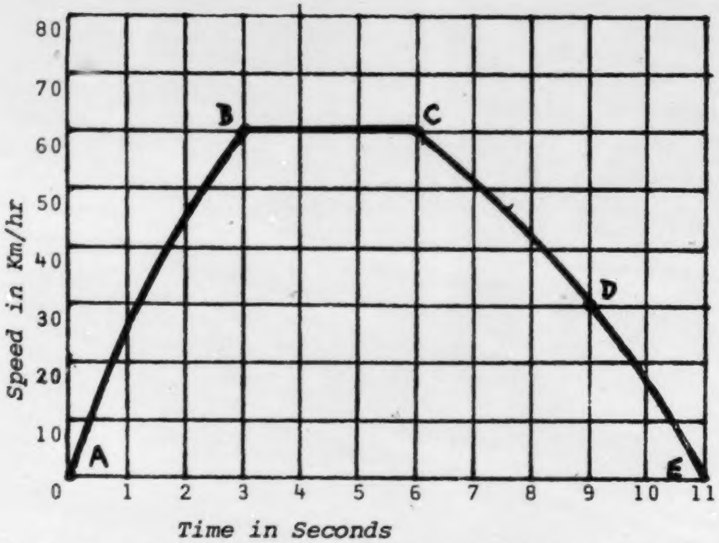
What is the rate of acceleration?

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.40 Newton's Laws of Motion

Subtopic/Specification/Content Number *Test Item*

C.6/10.42e The items below are based on the following graph:



1. What is the average acceleration from point A to point B? SHOW ALL WORK.

2. What is the average acceleration from point A to point E? SHOW ALL WORK.

3. There are two similar ways to solve the acceleration from point A to E. Why do they give different answers?

4. One of the methods is quick. What is its disadvantage?

5. One of the methods is slow. What is its advantage?

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.40 Newton's Laws of Motion

Subtopic/Specification/Content Number	*Test Item*
10.43 Action and Reaction	
A.5/10.43a	What is Newton's Third Law of Motion?
A.1/10.43b	Define and give an example of momentum.
C.1/10.43c	1. A heavy truck strikes a small car head on. Which way will the two vehicles move, if they remain stuck together? Explain your answer.

PHYSICAL SCIENCE

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES
10.50 Topic: Work

Objectives	(*Minimum Objectives)	*Activities*	*References*
*A.1/10.50a	The student should be able to define the term work.		
*C.1/10.50b	Using the formula W = f × d, the student should be able to calculate the amount of work he does when moving at a certain speed over a certain distance.		
*A.5/10.50c	The student should be able to list and explain three units for work.		

PHYSICAL SCIENCE

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.50 Work

Subtopic/Specification/Content Number	*Test Item*
A.1/10.50a	Define the term work.
C.1/10.50b	1. Run from the doorstep of the school to the school fence. Have a partner time your speed, and calculate the amount of work you have done. (HINT: What else do you have to know?) 2. Run up one flight of stairs and have a partner time your speed. Calculate the amount of work you have done. (HINT: What else do you have to know?)
A.5/10.50c	List and explain three units for work. Where do they come from?

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCE

10.60 Topic: Power

Objectives	(*Minimum Objectives)	*Activities*	*References*
*A.1/10.60a	The student should be able to define power and list three units for power.		
*C.1/10.60b	The student should be able to determine his own power rate of doing work and then calculate hid own horsepower rating.		

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCE

10.60 Power

Subtopic/Specification/Content Number	*Test Item*
A.1/10.60a	Define the term power and list three units for power.
C.1/10.60b	1. Lift a box supplied by your instructor, and have a partner time how fast you lift it. Find the mass of the box, and determine your own power rating. Convert this to horsepower. 2. Run a measured distance and have a partner time your speed. Calculate your power rating and convert it to horsepower.

10.00 UNIT: THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES
10.70 Topic: Energy Conversions

Objectives	(*Minimum Objectives)	*Activities*	*References*
*A.2/10.70a	The student should be able to list and briefly explain five forms of energy which may be changed into mechanical energy.		
*A.2/10.70b	The student should be able to list and briefly explain four situations in which mechanical energy is changed into some other form of energy.		

10.00 THE NATURE OF MECHANICAL ENERGY AND GRAVITATIONAL FORCES

10.70 Energy Conversions

Subtopic/Specification/Content Number	*Test Item*
A.2/10.70a	List five forms of energy that may be changed into mechanical energy, and briefly explain how this is done.
A.2/10.70b	List four situations in which mechanical energy is changed inot some other form of energy.